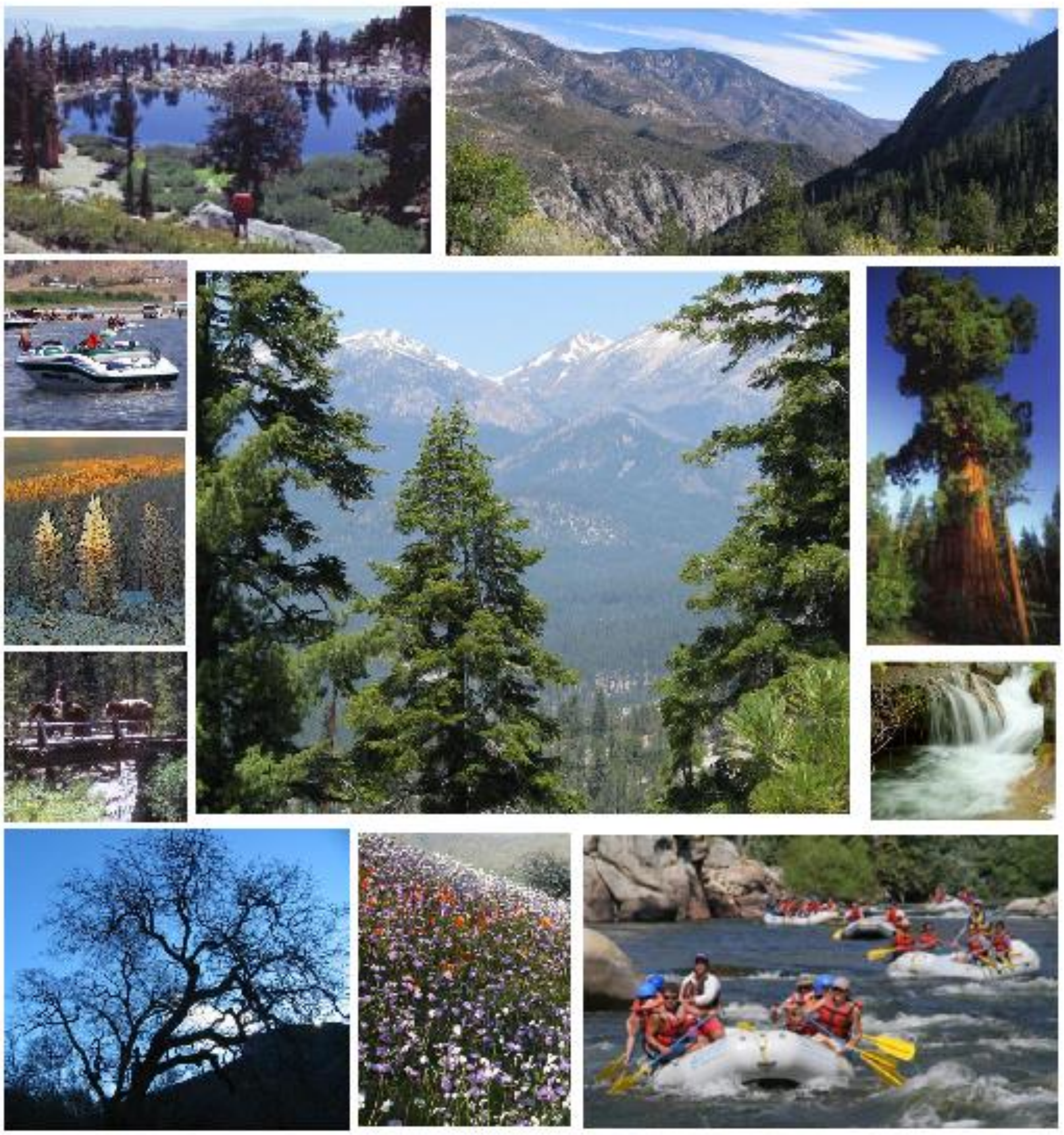
United States Department of Agriculture

Sequoia National Forest Assessment



Forest Service

Sequoia National Forest
Giant Sequoia National Monument

December 2013

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INTRODUCTION

Purpose of the Assessment

The 2012 Planning Rule provides the process and structure to create local land and resource management plans for the national forests in California. The rule establishes an ongoing, three phase process: 1) assessment; 2) plan development or revision; and 3) monitoring. The 2012 Planning Rule is intended to create understanding of landscape scale management. It takes an integrated and holistic approach that recognizes the interdependence of ecological processes with social and economic systems. The approach uses best available science to inform decisions along the way. Collaboration with stakeholders and transparency of process are key ways the 2012 Planning Rule guides creation of forest plans for the future.

The Sequoia National Forest Land and Resource Management Plan will consider a full range of multiple uses on National Forest System (NFS) lands where jobs are generated and economic opportunities are created.

This document represents the assessment stage of forest plan revision and is designed to rapidly evaluate readily available existing information about relevant ecological, economic, and social conditions, trends, and sustainability and their relationship to the current land and resource management plan within the context of the broader landscape. Assessments are not decision-making documents, but provide current information on planning topics.

Structure of the Assessment

The Sequoia National Forest is referred to throughout this document as "Sequoia National Forest", or "the forest". The Sequoia National Forest Land and Resource Management Plan is referred to as the "LRMP". The Giant Sequoia National Monument is referred to as the "Monument".

The Sequoia National Forest Assessment begins with this INTRODUCTION to provide background on the process and to describe the assessment area. The next section is RESOURCES MANAGED AND EXISTING PLAN OBJECTIVES to help the reader set the context as the Sequoia National Forest moves to forest plan revision under the 2012 Planning Rule. That is followed by an explanation of BEST AVAILABLE SCIENTIFIC INFORMATION. Next are the FINDINGS for the fifteen topics listed below. This section makes up the bulk of the assessment. CONCLUSIONS, REFERENCES, HELPFUL LINKS, and the Forest Service NON-DISCRIMINATION STATEMENT close out the assessment.

The Sequoia National Forest Assessment identifies and evaluates existing information relevant to the plan area for the following topics laid out in the 2012 Planning Rule:

1. Ecological integrity: terrestrial ecosystems, aquatic ecosystems, and watersheds
2. Air, soil and water resources and quality
3. System drivers and stressors
4. Baseline assessment of carbon stocks
5. At-risk species
6. Social, cultural, and economic conditions
7. Benefits people obtain from the assessment area: ecosystem services

8. Multiple uses: Fish/Plants/Wildlife, Water, Timber and Range
9. Recreation settings, opportunities and access, and scenic character
10. Energy and minerals resources
11. Infrastructure
12. Areas of tribal importance
13. Cultural and historical resources and uses
14. Lands status and ownership, use, and access patterns
15. Designated areas, including wilderness and wild and scenic rivers, and potential for designated areas

Living Assessment

Both the public and the 2012 Planning Rule envision wider and deeper levels of engagement in forest plan revision. There are a variety of ways the Sequoia National Forest has interacted with the public in the early stages of the planning process. There has been engagement with the public at numerous face-to-face meetings and technology has been used to interact virtually. Since 2010, the Sierra Cascades Dialog, a group made up of a broad spectrum of interested stakeholders, continues to be an important vehicle for engagement on forest planning. The on-line community called *Our Forest Place,* a non-Forest Service site, is where members interact on blogs and in discussion groups, and where they can find information on forest planning and current events. A WIKI site, the *Living Assessment*, was set up to allow information to be added to the 15 topic papers at both the bio-regional and forest scales.

The information found in each of the chapters in the *Living Assessment* is intended to describe current conditions and trends. By reaching out to stakeholders, there has been direct engagement in contributing to the content of these chapters, not just reviewing the information. Many interested stakeholders have added important and valuable input directly, creating a "living" body of work, in partnership with Forest Service scientists and specialists. This is an important shift in the approach to public involvement.

In January 2013, the Regional Planning Team and Sequoia National Forest staff began working with agency specialists, researchers, and interested stakeholders and providing their own initial contributions to the *Living Assessment*. Over the course of the next several months, the team monitored entries, gathered information, responded personally to questions and addressed concerns from contributors. They focused attention on topics where there was significantly more interest than others. All the information used in this assessment must be evaluated to ensure that it meets the standards of Best Available Scientific Information (BASI) as described in the 2012 Planning Rule. While the WIKI environment has been extremely valuable in capturing and evaluating the information to determine when there are definitive sources and where there are uncertainties or conflicting information, it has also presented some challenges.

The FINDINGS section represents the rapid assessment of existing information about relevant ecological, economic, and social conditions, trends, and sustainability. This section is thoroughly cited and the complete REFERENCES section is found toward the end of this document. The reader is also referred to more detailed information in snapshots taken of the chapters in the *Living Assessment*, which include chapters and line numbers. These snapshots also include an extended list of references.

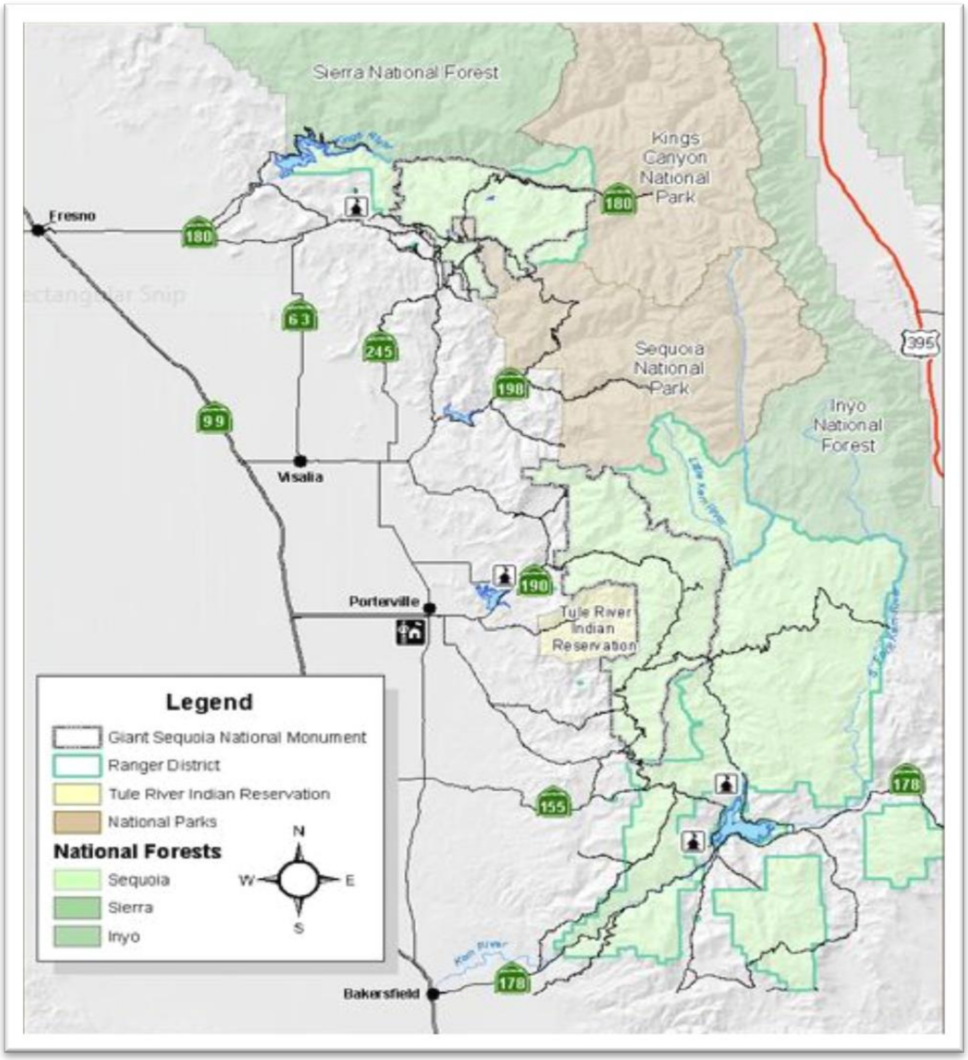
Maps of the Assessment Area

The first map below shows the Sequoia National Forest and where it lies within the State of California. The second map displays the boundaries of the Sequoia National Forest.

Sequoia National Forest within the State of California

The map below shows the Sequoia National Forest boundary. The Sequoia National Forest has two sections divided by the Sequoia and Kings Canyon National Parks. The boundary of the northern section, starting in Fresno County at Pine Flat Reservoir, follows the Kings River east to the intersection of its middle fork and south fork. The Sierra National Forest is on the north side of the river. The boundary then continues northeast along Junction Ridge past Wren Peak to the west edge of Kings Canyon National Park at Mt. Harrington. The boundary proceeds south, entering Tulare County, following the western edge of the national park to Kettle Peak, then runs west along the park boundary to Chimney Rock and Big Baldy. The boundary runs north from there, wrapping around the Grant Grove area of the park and south again thru the Redwood Mountain area. From there the boundary runs northwest past Eshom, Hartland, Pinehurst, Dunlap, and Oat Mountain, back to Fresno County and Pine Flat Reservoir.

The southern section of the Sequoia National Forest starts in the northwest at Blue Ridge in Tulare County. The boundary follows the Sequoia National Park boundary from there, east to the Kern River, then south following the river and boundary of the Inyo National Forest to Soda Flat. The boundary continues east away from the Kern River, following the Inyo National Forest boundary to the South Fork of the Kern River. The boundary runs south from there to Kern County and around the Lake Isabella Reservoir area. Within Kern County, the Scodie Mountains and the Piute Mountains are included as separate blocks of land at the southern end of the forest. The boundary around the Greenhorn Mountains runs from a point east of Bakersfield, then north from Kern County back into Tulare County. The western boundary of the forest then runs north, west of California Hot Springs, following the eastern and northern edges of the Tule River Indian Reservation to the Springville area and back to Blue Ridge.



Boundary of Sequoia National Forest

Assessment Area, History and Distinctive Features

High elevation lakes defined by towering conifers, deeply carved river valleys and huge granite monoliths describe the Sequoia National Forest. The Sequoia National Forest is the gateway to the southern Sierras, including the highly visited Giant Sequoia National Monument (Monument). The forest is divided into three ranger districts located in Tulare, Kern, and Fresno Counties. The forest is located along the western slope of the southernmost end of the Sierra Nevada Mountains. Elevations range from 790 feet in the Lower Kern River Valley, to 11,873 feet in the Golden Trout Wilderness.

The Sequoia National Forest was created in July 1, 1908 by President Theodore Roosevelt from the Sierra Forest Reserve. The forest was named for the giant sequoia trees. The forest is the origin of the headwaters of the Tule River and Deer Creek. The Kern River starts in southwestern Inyo County entering into Tulare County and the Sequoia National Forest. All these streams sustain the agricultural industry of the San Joaquin Valley. On April 15, 2000, President Bill Clinton proclaimed approximately 328,000 acres of the Sequoia National Forest as the Giant Sequoia National Monument. The Monument is in two portions. The northern portion surrounds General Grant Grove and other parts of Kings Canyon National Park and is administered by the Hume Lake Ranger District. The southern portion is directly south of Sequoia National Park and is administered by the Western Divide Ranger District, surrounding the eastern half of the Tule River Indian Reservation.

The elevation span under 12,000 feet, combined with the variability in aspect and slope created by deep river canyons, a variety of geology and soils, and precipitation primarily as rain at low elevations and snow at high elevations, creates an extremely high diversity of ecosystems across the forest. White fir is the predominant tree species on this forest and can be found between 5,000 and 7,500 feet elevation. This area provides an important component for biological diversity in the landscape of the western United States. The Sequoia National Forest is inhabited by over 2,000 plant species, and approximately 304 species of terrestrial wildlife: 194 bird species, 85 mammal species, 13 amphibian species, 25 reptile species, and nine native fish species. The forest is one of three native sites for the Pacific fisher, a threatened species, whose original range included much of the western United States and Canada.

The forest's geomorphic foundation consists primarily of an uplifted, westward-tilted Sierra Nevada block that has been deeply incised by large rivers as well as their tributaries. The most notable features include glacier-carved landscapes and impressive granite monoliths. Bedrock is primarily granite, along with limited metamorphic and volcanic presence, as well as glacial deposition in the lower river valleys. The terrain is dominated by steep slopes and rocky canyons, mixed with mild slopes and flat areas.

The Sequoia National Forest has a particularly diverse assemblage of plant communities and a high diversity of rare and endemic plants. This is because the forest is situated at the crossroads of five different geographic and floristic provinces: Sierra Nevada Mountains, San Joaquin Valley, Great Basin Desert, Mohave Desert, and Tehachapi Mountains. For example, the Kaweah fawn lily is isolated on three mountaintops in the central-western part of the forest and is the southernmost fawn lily in California. Fawn lilies are more commonly found in the northern Sierras and Oregon and Washington. Pierpoint Springs Dudley is a succulent herb which is only found on two marble outcrops in the middle Tule River Canyon. The Little Kern milkvetch only occurs in the Golden Trout Wilderness growing on Pliocene lava flow terraces.

Climate generally consists of warm, dry summers and cool, moist winters at the lower elevations, with harsher winters as elevation increases. Mean annual precipitation is 10 -15 inches, with snow above 5,000 feet at the northern end and above 7,000 feet elevation on the Kern Plateau.

The Sequoia National Forest provides a variety of recreation opportunities to local rural residents, nearby communities and towns, and to the highly urban areas along the California coastline, as well as international visitors. Facilities offer opportunities that range from highly developed campgrounds and picnic areas, to minimally developed overnight and day use areas that serve primarily as access points to trails, creeks, rivers and general forest areas, or for people who prefer to camp without the amenities that developed sites provide. The forest is best known for particular attributes or settings, including giant sequoias and their ecosystems.

The Sequoia National Forest encompasses 1,185,742 million acres of land and water. It has six areas designated as wilderness and one area proposed for wilderness in the Giant Sequoia National Monument, adding up to a total of 314,310 acres or 27 percent if the forest. These areas offer solitude and vast open spaces as part of one of the largest contiguous blocks of wilderness in the continental United States. The Giant Sequoia National Monument covers 328,315 acres or about 28 percent of the Sequoia National Forest.

The Sequoia National Forest provides tremendous opportunities for hiking, horseback riding, and mountain biking, as well as off road vehicle use on trails jointly maintained by the Forest Service and many partners. The forest is home to 33 giant sequoias groves. The Long Meadow Grove features the accessible Trail of 100 Giants that provides interpretation to hikers on the ecology of the giant sequoias.

The Sequoia National Forest provides opportunities for nature-based education to a wide variety of local and area residents. Programs like the Youth Conservation Corp and Wild Places provide opportunities to students from communities in and around the San Joaquin Valley to learn about natural resources, as well as to contribute to stewardship

The Sequoia National Forest has many historically significant sites. For instance, Hume Lake Dam is located in the northern portion of the Monument. The forest lies in the traditional territories of five federally recognized tribes, as well as a number of other tribes, groups, and tribal organizations. Tribal communities are important partners in forest management activities.

The Sequoia National Forest has been largely affected by fire suppression for almost a century. As a result, live and dead fuels have increased to abnormally high levels, greater than the natural range of variability. Historical logging, livestock grazing, hydroelectric power generation, and residential development have also influenced ecological conditions and management across the landscape. For example, prior to the mid-1900s, and to a lesser extent from the mid-1900s to the early-1990s, logging in the Sequoia National Forest typically consisted of removing many of the largest overstory trees. These actions resulted in substantial reductions in sugar, ponderosa, and Jeffrey pine and, to lesser extent, red fir forests.

Across the counties of the Sierra Nevada bio-region, population growth is expected to be greatest in the three-county region of Fresno, Kern, and Tulare Counties, which surround the Sequoia National Forest. By 2050, the population in these counties may increase by over 90 percent. This population is younger than the others in the bio-region and has the highest levels of poverty.

RESOURCES MANAGED AND EXISTING PLAN OBJECTIVES

Placed under federal protection and management in 1908, the Sequoia National Forest has met the public's needs for more than a century. With its giant sequoia groves, numerous rivers and streams, abundant natural resources, continuous wilderness, and a wide variety of recreation opportunities, this is one of the most popular national forests in the United States, highly valued by even those unable to visit.

Resource Management on the Sequoia National Forest

The Forest Service manages National Forest System (NFS) lands to sustain the multiple-use (consistent with the Multiple-Use Sustained Yield Act of 1960, 16 U.S.C. 528-531) of its renewable resources in perpetuity, while maintaining the long term health and productivity of the land. Resources are managed through a combination of approaches and concepts for the benefit of human communities and natural resources. Land and resource management plans (LRMPs) guide sustainable, integrated resource management of the resources within the plan area in the context of the broader landscape, giving due consideration to the relative values of the various resources in particular areas (Planning Rule, 36 CFR Part 219.1(b)).

The Sequoia National Forest LRMP was completed in 1988 and then amended in 1990 by the Sequoia National Forest Mediated Settlement Agreement (MSA) and by the 2004 Sierra Nevada Forest Plan Amendment, commonly referred to as the 2004 Framework. The 1988 Sequoia LRMP direction is provided through goals, followed by desired future conditions, then general management prescriptions and standards and guidelines. Finally, each management area has prescriptions, practices, outputs and activities. The 1988 LRMP lists goals for a wide variety of resources and uses including recreation, wilderness, wildlife, fish, livestock grazing, timber harvest, minerals, soils, water, air quality, cultural resources, transportation system, and fire management.

The emphasis of the 2004 Framework is to adopt an integrated strategy for vegetation management that is aggressive enough to reduce the risk of wildfire to communities in the wildland urban interface, while modifying fire behavior over the broader landscape. Direction is provided as management goals and strategies, desired conditions, management intents and objectives, and management standards and guidelines. The 2004 Framework addressed five problem areas: old forest ecosystems and associated species; aquatic, riparian and meadow ecosystems and associated species; fire and fuels management; noxious weeds; and lower west side hardwood ecosystems.

The Sequoia National Forest LRMP was amended by the Sierra Nevada Forests Management Indicator Species ROD in 2007. This decision amended the plans for the national forests in the Sierra Nevada to adopt a common list of management indicator species (MIS).

The Sequoia National Forest LRMP was also amended by the Giant Sequoia National Monument Management Plan (Monument Plan) and ROD. The Monument Plan provides the strategic direction at the broad program level for managing the Monument and its resources over the next 10 -15 years. It includes the direction required by the presidential proclamation that created the Monument, and it replaces, in its entirety, all previous management direction for the Monument, including the direction in the 1988 Sequoia National Forest LRMP for that part of the Sequoia National Forest. It is the single management plan for this area. While the Monument Plan is a stand-alone document, it is also a subset of the entire Sequoia National Forest LRMP.

Budgets

The Sequoia National Forest receives its funding from three sources: Appropriations, Revenue and Reimbursements. All national forests receive the majority of their funding from congressional appropriations.

Revenue is the funding earned through commercial ventures such as mining, timber sales, recreational activities and donations. The Sequoia National Forest is not authorized to collect revenue from the majority of its commercial activities. Instead, it receives a portion of the collections via trust funds which are created from the proceeds of these activities. Similarly, the forest does not collect revenue directly from any of the concessionaire-owned facilities on the forest. All of the concessionaries operate under special use permits, which allow the forest to receive some compensation. The Recreation Fee Demonstration Program in 1996 first enabled the Sequoia National Forest to charge fees to visitors at certain recreational sites. The subsequent 2005 Federal Land Recreation Enhancement Act increased the ability of national forests to recover their expenditures through fee collections.

In terms of reimbursement, the forest receives funding for work performed by Sequoia National Forest personnel on behalf of other agencies such as the Corps of Engineers, Bureau of Land Management, other Forest Service units, and state agencies. The work performed is typically road and trail maintenance.

History

Between 2008 and 2013, the overall budget of the Sequoia National Forest grew from $21 million in 2008 to $23 million in 2013. After adjusting for inflation, actual spending power of the forest decreased. Funding for fire pre-suppression and hazardous fuels reduction programs has remained level. Appropriations for these two programs in 2009 and 2010 were higher than the other three years. Revenue and reimbursement accounts were lower as well. With the reduction in the timber program, revenues declined and with inflation, reimbursements decreased in these accounts.

Strategies

This financial analysis reveals a decline in appropriated funding and in turn, an increased dependency on other revenue. Therefore, many forest strategies focus on cost reduction and revenue generation. One important strategy is to increase the number and effectiveness of partners and volunteers. Other strategies focus on protecting and sustaining the forest ecosystem and maximizing recreation opportunities by reaching out to surrounding communities.

Revenue Opportunities

Since 1908, every national forest has ceded to the U.S. Treasury receipts generated by the sale or commercial use of commodities on that forest. Twenty-five percent of these receipts were then sent back to the states in order to fund county schools and roads. Most of the capital came from timber sales. In the late 1980s, timber sale receipts began declining, and counties, especially those with a high percentage of National Forest System land, lost a significant source of funding.

In October of 2000, Congress passed the Secure Rural Schools and Community Self Determination Act to address declining federal receipts to local governments. Title II of that act gave counties access to funds for reinvestment in forest and watershed health. The Federal Lands Recreation Enhancement Act of 2005 is another funding source. Under this legislation, the Forest Service is able to charge user fees to its recreation visitors. The Sequoia National Forest retains 95 percent of the revenue from its interagency pass sales and from fee collection from recreation sites and from recreation special uses. The Sequoia National Forest is also able to charge modest fees at campgrounds, rental cabins and day use areas. In addition, through the Sequoia's Receipts Act, a portion of forest receipts are made available for land acquisition.

Trends

Although annual funding for the Sequoia National Forest has, on average, been around $27 million since 2008, the distribution of the funding has changed dramatically. The most notable change in distribution comes from revenue, which has declined since the 1990s. This decline is primarily due to the substantial reduction in timber harvesting on the forest. Another notable trend is the shift in appropriated funding from core forest operations to fire management. As the proliferation of wildfires became a nationwide concern at the turn of the last century, a series of executive directives were enacted to ensure that fire prevention and suppression measures received ample support.

Apart from the funding supplied to the forest during emergencies, fire funding comes from two sources: hazardous fuels reduction and fire pre-suppression and preparedness. Funding for hazardous fuel reduction pays for reducing hazardous under brush and vegetation in order to prevent the spread of active forest fires. Fire pre-suppression and preparedness funds pay for training, supplies, equipment, and public awareness campaigns. Between 2008 and 2013, fire-related appropriations to the Sequoia National Forest have been around $11 million. This fire-related appropriation is critical for preventing catastrophic wildfires, but leaves less to support other forest operations.

Forest facilities operations and maintenance programs have experienced the biggest shortfall. As federal appropriations decline, maintenance of the forest's physical infrastructure falls behind. Other program areas that experienced significant funding shortfalls were timber, recreation, law enforcement, and planning. Although not as large in terms of dollar amounts, trails maintenance and management of specially designated areas are also experiencing funding declines.

The Human Factor and the Sequoia National Forest

The list of forest accomplishments grows every year as a result of the dedication and perseverance of the Sequoia National Forest team. This team is made up of dedicated employees, committed volunteers and interested and engaged partners. The forest continues to work side-by-side with other federal agencies, state and local governments, communities and individuals, tribes, nonprofits, corporations, and other organizations to build a collaborative relationship to meet the mission of the agency. Modern community involvement requires the Forest Service to strengthen ways it can be a constructive community member and contribute to the wellbeing of the community, over and above financial support. True partnerships involve engaging in long term relationship-building, joint planning, goal-setting and implementation, accountability and "win-win" outcomes. Relationships with the tribes have always been important to the Sequoia National Forest and continue to be critical as forest planning continues for the future. Collaboration with tribal communities benefits both the landscape and the people who care deeply about it. Cooperating with and planning for the future alongside other governmental agencies, at the local, state and federal levels is extremely important in order to gain efficiencies and provide the best possible services to the public.

Risk Factors

The International Organization for Standardization defines risk as the "effect of uncertainty on objectives." In this definition, uncertainties include events which may or may not happen, and those caused by ambiguity or a lack of information. The definition also includes both positive and negative impacts on objectives. The Bio-Regional Assessment addressed a number of uncertainties, or risk factors, such as climate change, population growth, demographic and value shifts, commodity market prices, regional economic conditions, political influence, and federal and state budgets.

In the short term these risk factors can impact the strength, frequency and intensity of fire, floods, weather events, insect and drought-related tree death, and even major court precedence. In the longer term, the strength, frequency and intensity of land use change, local economic trends, use patterns, and ongoing project litigation can be impacted.

The risks to the Sequoia National Forest include a number of uncertainties, such as climate change, population growth, demographic and value shifts, commodity market prices, regional economic conditions, political influence, and federal and state budgets. Other risk factors to consider are communication, expected program budgets, skill and expertise deficiencies, time impacts, lack of information, and cooperation of others.

Risk factors are discussed in the body of the assessment in the terms of changes over time, trends, and information gaps.

BEST AVAILABLE SCIENTIFIC INFORMATION

This section explains 1) how the best available scientific information (BASI) was used in developing the assessment, and 2) how key scientific information was determined to be BASI, based on what is most relevant, accurate, and reliable.

In developing the chapter papers for the *Living Assessment*, Forest Service experts provided information supported by publications, scientific assessments, federal agency inventory and monitoring data, and other sources of scientific information, such as expert opinion where available and which addressed the 15 topics.

The initial information on trend and conditions was then drafted and made available to the public on the *Living Assessment* and the Sequoia National Forest websites. Stakeholders provided feedback on the content of the topic papers, added references and information directly, or submitted feedback on the content in email or hard copy letters. Stakeholders were asked to provide alternate or conflicting data sources and information, to not directly replace other valid information, and to provide references to support their additions in order to help the Forest Service evaluate conflicting views on conditions and trends. There were varying levels of response to that request.

Since the *Living Assessment* pages remain open to editing, a snapshot of the Sequoia National Forest chapters on the *Living Assessment* website was captured on August 2, 2013 so that a fixed set of information could be evaluated. The Forest Service followed the direction and guidance in the 2012 Planning Rule draft directives regarding the information to be collected to describe condition and trend, and to make sure appropriate readily available information was considered in this forest assessment.

The Forest Service used the topic papers for the Sequoia National Forest, the Science Synthesis, the Bio-Regional Assessment, and other sources to identify information to be included in this assessment.

The information from these sources was evaluated to determine if it was relevant to the scope and scale of the question at hand, if it was accurate, and if it was reliable. High quality and valid scientific information was considered particularly valuable. This type of information is characterized by clearly-defined and well-developed methodology, logical conclusions, reasonable inferences, adequate peer-review, suitable quantitative methodology, proper spatial and temporal context, and the use of relevant and credible citations.

To be relevant, the information must pertain to the 15 topics under consideration at spatial and temporal scales appropriate to the plan area and to a land management plan. Relevance in the assessment phase means scientific information that is relevant to the conditions and trends of the 15 topics in 36 CFR 219(b), or to the sustainability of social, economic, or ecological systems (36 CFR 36 219.5(a) (1)).

Accuracy and reliability of relevant information was determined by comparing the scientific certainty and quality of the information, and using the most scientifically certain information available. Information from the chapter papers without appropriate supporting citations or references was considered to be less certain.

If the information appeared to be of comparable scientific certainty, then both points of view were carried forward and a data gap was identified as to the final conclusions. In this way conflicting information will be made available during public feedback opportunities, collaboration and the internal review process to verify and validate that the information meets the criteria for BASI. An assumption of the planning process is that public feedback will help ensure that relevant, accurate, and reliable information is considered.

Throughout the planning process, if competing scientific perspectives are found and it is an important planning issue, science review may be requested to critically evaluate the relevance, accuracy, and reliability of the competing information, and to determine the best available science to assist the responsible official in making planning-related decisions.

Key assumptions in determining BASI, in addition to those documented in the assessment, are documented in the administrative record. References included in this assessment reflect the most relevant documents, given the scope and scale of the assessment, and those determined to be BASI.

FINDINGS

Chapter 1: Ecological Integrity

Important Information Evaluated in this Phase

Ecological integrity is defined as the degree to which ecosystems are represented across the forest and functioning properly (Safford et al. 2012a). For example, meadows are still well represented and are not substantially reduced in extent. Forests still provide habitat for native plant and animal species at levels that allow them to persist through fire, drought, and climate change.

In more technical terms, the 2012 Planning Rule draft directives define it as:

> the quality or condition of an ecosystem when its dominant ecological characteristics (for example composition, structure, function, connectivity, and species composition and diversity) occur within the natural range of variation and can withstand and recover from most perturbations imposed by natural environmental dynamics or human influence.

Biodiversity, or the living component, is central to ecological integrity. Most simply, it is the diversity of life.

More formally, according to the Congressional Biodiversity Act HR1268 (1990):

> Biological diversity means the full range of variety and variability within and among living organisms and the ecological complexes in which they occur, and encompasses ecosystem or community diversity, species diversity, and genetic diversity.

In this chapter, conditions and trends of ecological integrity are described and evaluated separately for the three major ecosystem types: terrestrial, aquatic, and riparian.

The primary data sources used were Forest Service databases. Additional information was compiled from the recent Sequoia and Kings Canyon National Parks Resource Condition Assessment (USDI 2013). Information was also taken from the July and August snapshots of Chapter 1 on the Living Assessment for the Bio-Regional and Sequoia National Forest. Finally, substantial information was derived from literature reviews conducted by the Forest Service Pacific Southwest Region Ecology Program on the Natural Range of Variability of dominant vegetation types for the Bio-Regional Assessment (Safford 2013, Meyer 2013a and Meyer 2013b, Estes 2013, Merriam 2013, Gross and Coppoletta 2013). The Science Synthesis was developed for the southern Sierra Nevada by the Forest Service Pacific Southwest Region Ecology Program; individual chapters used included Hunsaker et al. (2013) and Collins and Skinner (2013).

Nature, Extent, and Role of Existing Conditions and Trends

These assessments focus on the current condition of the terrestrial, riparian and aquatic ecosystems of the Sequoia National Forest. Current conditions, special habitats, biodiversity, ecological integrity, and natural range of variability for these three major ecosystems are assessed. Emphasis was on lands on the

Sequoia National Forest outside of the Giant Sequoia National Monument. In some sections, broader patterns for the larger bio-region were also discussed.

Terrestrial Ecosystems

Land-based, or terrestrial ecosystems, are diverse on the Sequoia National Forest. There are changes with elevation, and north to south and east to west. Floristically, the High Sierra Nevada, Central Valley, Southern California Mountains, Great Basin Desert, and Mojave Desert are all represented here. The forest can be roughly divided into three distinct ecological environments: the Greenhorn Mountains, the Kern Plateau, and the Breckenridge, Piute, and Scodie Mountains. The Greenhorn Mountains are the wettest, and all of the giant sequoia groves on the forest are located here. The areas with this magnificent tree were covered in the recent Giant Sequoia National Monument Plan, and are only included here for context. To the east of the Greenhorn Mountains, the Kern Plateau rises to over 9,000 feet. The Breckenridge, Piute, and Scodie Mountains are islands in the midst of lowlands and are influenced by the nearby Mojave Desert. These southern mountains are drier than the Kern Plateau or the Greenhorns.

The photo below shows the drier landscapes of the mountains in the southern part of the Sequoia National Forest. In the foreground there is a large, jagged rock outcrop that has sparse vegetation. On either side, there are small clumps of low growing shrubs, and small white fir and Jeffrey pine trees. These cover less than 20 percent of the area. In the vista, there are ridges of dry, openly vegetated forests, shrublands, and grasslands, with frequent rock outcrops.

Southern portion of Sequoia National Forest

In contrast, the Kern Plateau shown in the photo below has a mosaic of large meadows, forests, and rock outcrops. The bottom half of the photo shows a wet meadow near Church Dome with a dense cover of green sedges, and scattered wildflowers. There are some drier portions of the meadow at the edge on the left dominated by grasses rather than sedges and show up as a light tan. This is a typical pattern of Sierra meadows, with drier areas occurring in a "bathtub ring" around the meadow edges. The upper half of the photo shows a forested ridge, punctuated by rock outcrops that stick above the trees. Mixtures of mature and old growth red fir and Jeffrey pine have a moderate to dense canopy cover of 40 to 80 percent on the slopes. Around the meadow edge, a band of mature and old growth lodgepole pine and some groves of aspen occur.

Kern Plateau on the Sequoia National Forest

The Sequoia National Forest encompasses a broad range of habitats and elevations, ranging from blue oak woodland at 1,000 feet, to alpine fell fields at over 12,000 feet. At the lowest elevations, rising above the valley floor is the foothill zone which extends up to the montane zone. Blue oak woodlands, chaparral, and grasslands dominate the foothill zone. Ponderosa pine and mixed conifer forests dominate the montane zone. Next the upper montane zone is comprised of a mosaic of red fir forests, open Jeffrey pine woodlands, meadows, and montane chaparral. At the highest elevations, the sparsely vegetated subalpine and alpine zone occurs. To the east of the Kern River, precipitation is lower and vegetation is more open and dominated by Jeffrey and lodgepole pine. To the south, the Piute, Breckenridge, and Scodie Mountains are even drier, and share many similarities with the southern California mountain ranges. There is even an area of desert influenced pinyon-juniper. Massive areas of rock outcrops occur throughout all of these vegetation types. Herbaceous plant species contribute most to plant species richness.

Foothill Zone

The foothill zone of the Sequoia National Forest (16 percent of the area outside of the Giant Sequoia National Monument) captures a small proportion of the western foothill belt which is mostly in private ownership throughout the Sierra Nevada. Non-native grasses and herbs are dominant around oaks. Tree-dominated plant communities are blue oak woodland or savannah with foothill pine, California buckeye, and interior live oak present to varying degrees. Valley oak also occurs.

The photo below shows typical blue oak woodland in the lower elevation foothill zone of the Sequoia National Forest. Widely spaced blue oak trees, a dense carpet of dry, annual, non-native grasses can be seen on gently sloping (less than 30 percent slope) hills. Tree cover is variable ranging from 1 to 60 percent but averaging less than 30 percent. The trees are all mid-sized with diameters less than 10 inches and have full, rounded crowns. Seedlings and saplings are noticeably absent.

Blue Oak Woodland on the Sequoia National Forest

Montane Zone

At lower elevations, mixed stands of canyon live oak and black oak with scattered pines are found. In drier areas of the forest, black oak is an important component of many mixed conifer stands, particularly at the lower elevations and on drier aspects (south and west). Mixed conifer and yellow pine (ponderosa and Jeffrey) forest dominates the montane zone across most of the forest (46 percent of the assessment area). In addition to these species, incense cedar, and white fir are found. In the Giant Sequoia National Monument, giant sequoia is an important and dominant component.. In drier areas of the forest, including the Kern Plateau and the Scodie mountains, open woodlands dominated by Jeffrey pine or pinyon pine are more common.

The photo below is of a mixed conifer forest in the drier, Kern Plateau. An open, widely spaced stand of large (greater than 20 inch diameter) Jeffrey pine with scattered small white fir trees across a gently sloping plain are seen. Canopy cover is about 30 percent. The forest floor contains irregularly placed, low growing (less than 3 feet tall) small patches (less than 10 feet across) of young pines and manzanita shrubs. They cover about 20 percent of the forest floor. In between, a fairly continuous, but light layer of pine needles and cones is spread.

Mixed conifer in the Kern Plateau on the Sequoia National Forest

Upper Montane Zone

Upper montane forests occur above mixed conifer, occupying one-quarter of the assessment area, where snow is the primary form of precipitation. Red fir forests with Jeffrey pine on the rockier sites occur in the northern half of the forest. In the southern half of the forest, red fir is replaced by white fir. On more productive sites, western white pine is also found. In wetter areas, where the water table remains high in the summer, pure stands of lodgepole pine occur. Montane chaparral may cover extensive acreage in this zone, sometimes naturally on thin, rocky soils or in response to natural disturbances such as fire or avalanches. Rock outcrops are common and often support diverse and sometimes rare understory plants.

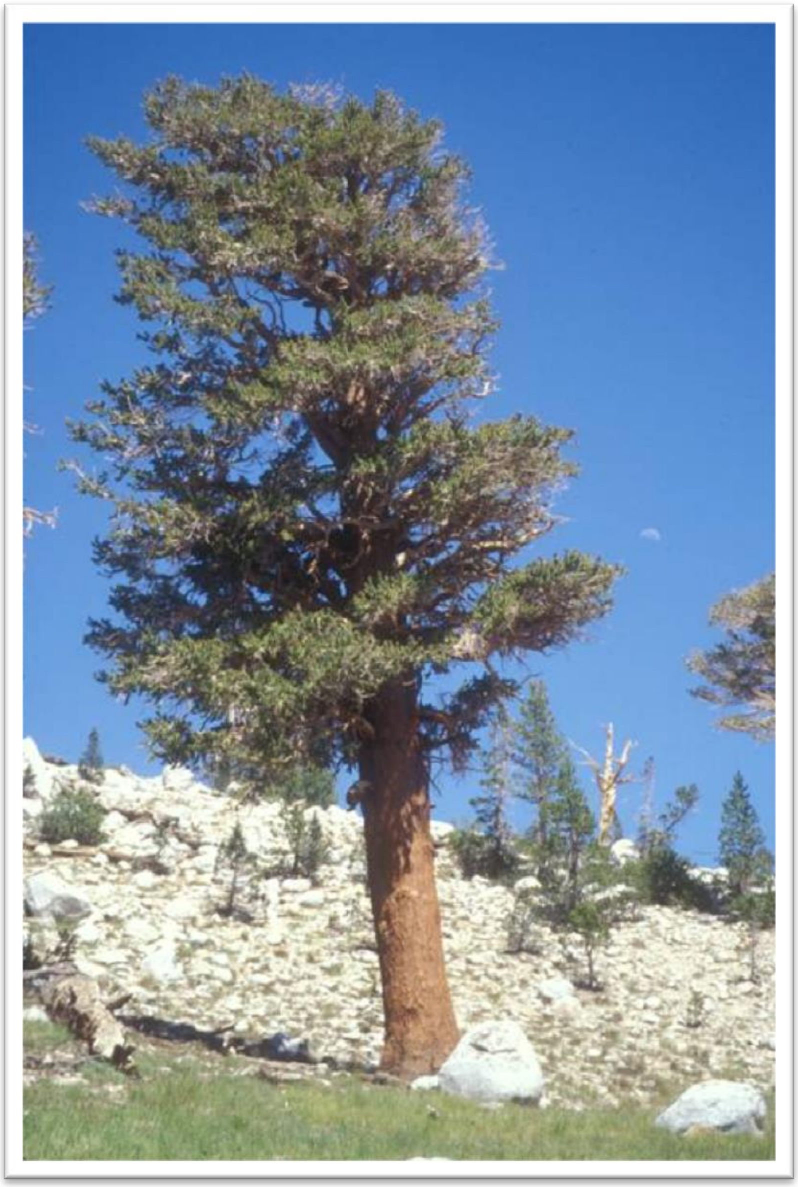
A dense, old growth stand of red fir is shown in the photo below. Variably spaced, mostly large (greater than 30 inches diameter) red fir trees occur in a monotypic stand on a moderately sloping (30 percent) site. A few pole-sized (6 to 12 inch diameter) trees are scattered. Tree cover is high, exceeding 60 percent in most places. In the foreground, there is a short stub of a rotten snag, less than one foot tall. Some of the bases of the large trees are curved at the base, indicating that either the soil is unstable and moving downslope, or snow accumulates upslope against the boles of the trees. The forest floor is visibly bare of grasses or herbs, covered by a continuous layer of tree litter.

Red firs stand on the Sequoia National Forest

Subalpine and Alpine Zone

The subalpine zone has stands of red fir and open, windswept pines, and covers less than five percent of the area, although there is a large and gradual transition between upper montane and subalpine ecosystems, making the distinction difficult. Some stands of mountain hemlock are found in this transition zone. The uncommon foxtail pine is found in the alpine zone as well as lodgepole pine in harsh, windswept areas. Early successional montane chaparral can cover extensive acreage in this zone, sometimes naturally on thin, rocky soils or in response to natural disturbances such as fire or avalanches. The vast majority of wet meadows are found with the montane and subalpine areas of the forest. The alpine zone is generally referred to as “above timberline” but may have krummholz or stunted trees. It supports a rich understory flora of over 600 species, 200 of which are limited to that zone (Sawyer and Keeler-Wolf 2007).

The picture below is of a very old, lone foxtail pine. It stands by itself dominating the picture and behind it is a large field of rock talus sloping gently up. Throughout the rock field in the background, there are widely scattered smaller, stunted trees. The foxtail pine tree has a large, densely spaced crown, covering the top half of the tree. The left side is narrower than the right side, indicating that wind blows from the left. The trunk of the tree is large, at least 20 to 30 inches in diameter and smooth. Both of these suggest the tree is very old, likely several centuries at least. In the foreground, a dense, dull green carpet of grasses or sedges is visible. This is a small patch of dry meadow.



Foxtail pine at high elevation

Characteristics of Ecological Integrity

Ecological integrity is simple in concept to define, but more difficult in practice to assess. Under the 2012 Planning Rule, "natural range of variability" is a key means for gauging ecological integrity. Ecosystem sustainability is more likely if ecosystems are within the bounds of natural variation, rather than targeting fixed conditions from some point in the past (Wiens et al. 2012). For a number of important ecological characteristics, such as snags or mixes of habitat types, there is limited or highly uncertain information on the natural range of variability available. A combination of two ways to assess ecological integrity was included here.

A limited suite of ecosystem characteristics were selected to assess ecological integrity based on:

- information was readily available
- characteristic is relevant to key issues and sensitive to drivers and stressors
- characteristics represent elements not covered in other chapters

These included:

- natural range of variability of vegetation
- vegetation diversity (communities, within-stand complexity, large trees, snags)
- special habitats (e.g. aspen, complex early seral, old forest)
- fire as an ecological process
- connectivity (overall, old forest, and special management areas)

Natural Range of Variability

Comprehensive, scientific literature reviews on natural range of variability were compiled. The following is an overview.

Consistent with trends across the entire assessment area, terrestrial ecosystems on the Sequoia National Forest are predominantly outside the natural range of variability (NRV) for key indicators of ecological function, structure, and composition. The exceptions are the upper montane and subalpine forests and shrublands to the east of the Kern River, where a substantial area has had fire restoration. The patterns vary by major elevational zone and are described below.

Foothill Zone

Overall, the vegetation and fire patterns in this zone are outside of the range of variability (Estes 2013, Merriam 2013, and Sawyer 2013). Modern oak understories are dominated by nonnative European annuals.

The foothill zone of the forest captures a small proportion of the western foothill belt which is mostly in private ownership throughout the Sierra Nevada (USFS 2001). Nineteenth century livestock grazing is considered to be the primary factor in changes in the blue oak foothill woodlands (Vankat and Major 1978). Vegetation is mostly out of the natural range of variability as a result of persistent non-native species, urbanization, water development, changed fire regime, and agricultural uses. Current conditions and trends reflect similar pressures.

Blue oak woodlands in the western Sierra Nevada display considerable fragmentation. Oak woodlands largely exist on private lands (greater than 90 percent), where conflicts with agriculture, grazing, water use and development exist. Expected increased urbanization will lead to increased pressures on oak woodlands. Blue oak woodlands are vulnerable to climate change because of their location at the edge between the hotter and drier valley floor and foothills (USDI 2013). Favorable conditions will migrate up slope and northward. Some oaks (e.g. interior live oak, scrub oak) may benefit from climate change in the short term, given that mature trees are generally drought and fire resistant. Although not currently exposed, oaks are sensitive to both insects and disease which may become significant in the future, such as the golden-spotted oak borer. Seedlings and saplings, however, are sensitive to soil moisture and precipitation, affecting the long term vulnerability of the oak woodland system. Predation of saplings by cattle and deer, and low levels of oak regeneration and recruitment have been evident for some time, and increase vulnerability in the long term. While disturbances like fire are natural, frequency and intensity of fires outside their historic range of variation may cause a change in vegetation type (USDI 2013).

Because of the combination of these factors, the small amount of this vegetation type under public land management is disproportionately important for ecological integrity. More detailed information can be found in the August 2, 2013 snapshot of the Sequoia National Forest Living Assessment Chapter 1, lines 183-225.

Montane Zone

Composition, structure, and fire regimes have changed considerably since pre-settlement times (Van de Water and Safford 2011), and are largely outside the natural range of variability in most of the montane zone. Areas in the Kern Plateau where fire has been restored are less deviated. Pines and oaks have decreased and shade tolerant species, such as cedar and fir, have increased. White pines across the Sierra Nevada are currently threatened by a combination of factors including outbreaks of native and exotic insects and diseases, altered fire regimes, air pollution, and climate change (USDI 2013). Compared to past conditions, forest density is greater, tree canopy is denser, and small and medium trees are more dominant in the forest. Within stand variation in tree size and density has decreased. Drought has triggered tree mortality in mixed conifers; and large tree mortality has doubled in the last 2-3 decades across the western United States. This pattern is associated with increases in temperature and droughts.

Upper Montane and Subalpine Zones

Coniferous forest types within these zones are dominated by red fir and lodgepole pine with an increasing component of western white pine and some stands of mountain hemlock. Rare tree species found only at high elevations may be more vulnerable to disease, competition from historically lower elevation trees as temperature changes (Meyer 2013a,b). Montane chaparral can cover extensive acreage in this zone, sometimes naturally on thin, rocky soils or in response to natural disturbances such as fire or avalanches. As temperatures warm, changes in fire frequency could maintain this type of habitat (Estes 2013, Meyer 2013a, b) Meadows are rich in fens and many are inhabited by Sphagnum moss. Meadows in the areas with non-granitic geology (metamorphic and volcanic rock basin geochemistry) are prime habitat for rare moonworts, and more of these unusual fens are being found in the southern Sierra each year. Meadows are particularly vulnerable to changes in snowpack and earlier spring melt already experienced in the southern Sierra Nevada with more changes expected in the future with climate change (Safford et al. 2012, USDI 2013). Many forest endemics and other rare plants such as the Kaweah fawn lily, Pierpoint Springs Liveforever and the Piute Buckwheat grow exclusively on rock outcrops within montane and sub-alpine zones.

Since alpine environments are found at the extreme end of the temperature gradient in the Sierra Nevada, the life forms that are narrowly adapted to those conditions essentially have “nowhere to go”, making them among the most vulnerable to climate change (USDI 2013). Due to the high elevation on the

Sequoia National Forest, the last cold refugia may be in the mountains surrounding the Kern Plateau. These alpine ecosystems are one the more threatened due to rapid climate change (Loarie et al. 2009).

Vegetation Diversity: Plant Communities

The Sequoia National Forest has a particularly diverse assemblage of plant communities because of its proximity and overlap with the Sierra Nevada, San Joaquin Valley, Great Basin, Mohave Desert, and Tehachapi Mountains. Further, the Kern River flows north to south and provides a corridor for plants from these different landscapes to migrate and intermingle in common areas. Examples include: mixed pinyon pine and blue oak in the west Piute mountains; red bud and purple sage shrubs; flannel bush and Joshua trees; and diverse trees together or near each other in the vicinity of Sherman Pass including sugar pine, foxtail pine, ponderosa pine, Jeffrey pine, western white pine, red fir, white fir, and Utah juniper. Systematic inventories of these unusual plant combinations are limited. The diversity may rival that of any other national forest in the California, except perhaps the Klamath Mountains.

The picture below shows the Great Basin type of habitat on the southern end of the forest, deep blue sky, dry hills in background, sage and other dry habitat shrub. In the foreground is one of the rare plants of purple sage found on the forest. The abundant purple flowers are characteristic of this shrub.

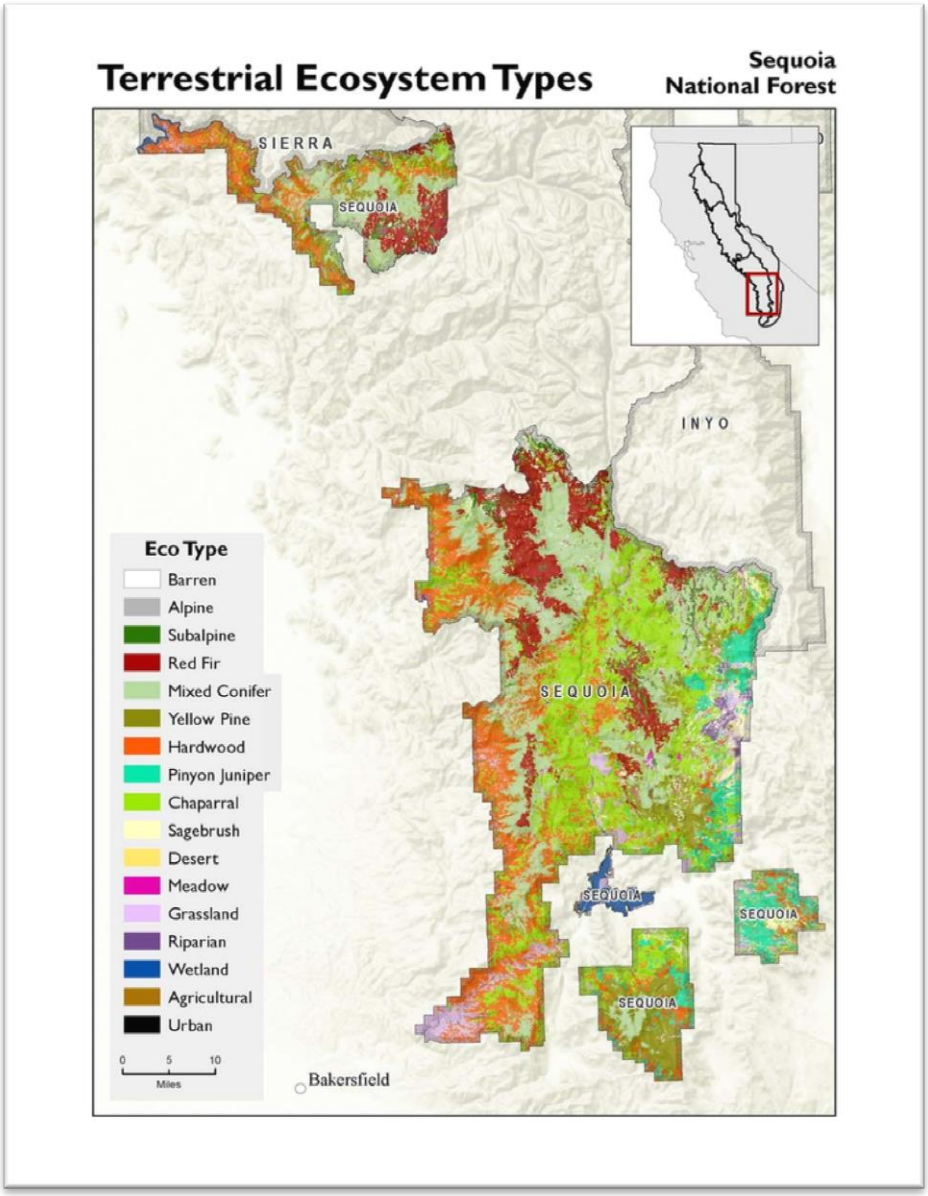
Purple Sage in the southern part of the Sequoia National Forest

Vegetation Diversity: Type and Successional Stage

The California Wildlife Habitat Relationships (CWHR) classification system was used as one way to characterize vegetation diversity (CDFG 2008). This comprehensive system is used throughout California's national forests, and it is the system is used here to provide an overview, or broad-scale filter, of habitats on the Sequoia National Forest. It is based on dominant species, average size and canopy density. It is limited by lack of some key habitat characteristics (North and Manley 2012) such as shrubs, snags, large trees, or within-stand complexity, but is what is readily available. To supplement this information, other sources of existing data, especially from Forest Inventory and Analysis (FIA) plots, were also assessed.

The Sequoia National Forest contains 32 terrestrial vegetation types, including 19 tree, six shrub, three herbaceous, three desert, and one sparse/rock outcrop habitat types. Outside of the Giant Sequoia National Monument, approximately 60 percent is non-forested (shrub, herb, meadow, grassland, or sparse/rocky) habitat. Out of the remainder of the area, about 10 percent is classified as oak habitat and 20 percent is conifer habitat.

The map below shows the range of CWHR types based on dominant species or vegetation type. Distinct bands of vegetation that change from west to east, north to south, and with elevation are evident. In the western one quarter of the forest, oak woodlands and mixed conifer forests dominate at low and mid-elevations and are shown in orange and light green shades. Above that, a large band of red fir in the north, and a narrow band half-way down the forest are shown in brick red shade. Red fir is bounded by montane mixed conifer forests below it on both the east and west. In the center of the forest there is a large swath of yellow-green that denotes chaparral. The main body is in a north-south band in the Kern River Canyon that bisects the forest (about one-fifth of the area). To the east of the canyon, throughout the Kern Plateau, large patches of chaparral also occur intermixed with mixed conifer, red fir and meadow areas, with subalpine forests confined to the northern portion of the plateau. These chaparral patches are where fire has occurred in these drier portions of the forest, or where shallow rockier soils occur. They encompass about one-tenth of the forest. There are also large areas of chaparral in the southern Breckenridge and Scodie Mountains. Throughout the Kern Plateau, there are patches of varying sizes of Jeffrey pine and subalpine forests and woodlands. These are located to the east and south of red fir forests and have more of a desert climate influence. At the lowest elevations on the east and across most of the Scodie Mountains and eastern portion of the Piute Range, large patches of pinyon-juniper woodlands occur. These encompass above 10 percent of the forest area. Finally, there are some large areas of annual grasslands in the southwest portion of the forest in the foothill area.

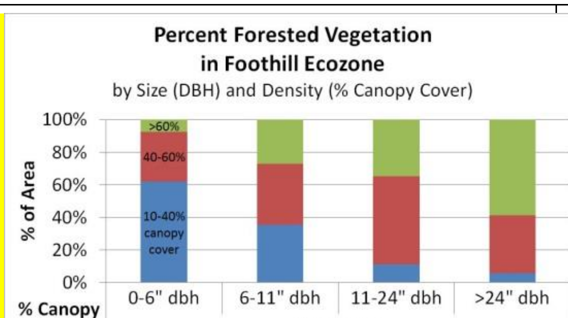


Range of California wildlife habitat relationship types
based on dominant species or vegetation type on the Sequoia National Forest

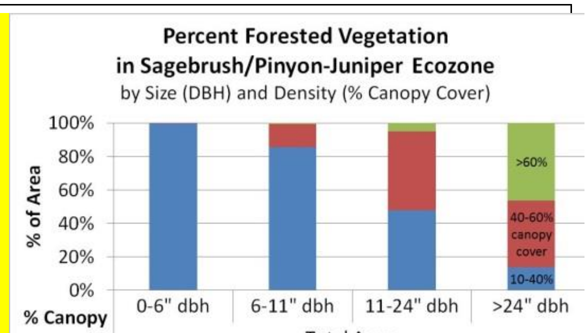
Habitats are further classified by combining the three CWHR criteria: vegetation type, size and canopy cover to create primary habitat types. Out of the oak and conifer woodlands and forests in the assessment area, nearly 60 percent is classified as conifer and the rest oak or oak-conifer habitat. The majority of these areas are mid-seral conifer habitats (almost half), followed by late seral conifer (about 15 percent), or mid or late seral hardwood forests and woodlands (about 17percent).

More detail on combinations of average stand tree diameters and canopy cover categories is shown in the figures below. There are separate graphs for each ecological zone, including foothill, montane, upper montane and subalpine forests. The left axis of each displays the percentage of area occupied by each category, from 0 to 100 percent. The bottom axis displays different diameter categories from saplings (0.1-6 inch diameter), pole (6-12 inch diameter), small trees (12-24 inch diameter) and large trees (greater than 24 inch diameter) from left to right. Each bar shows up to three canopy cover classes. The blue color is on the bottom and displays sparse to low canopies (10-40 percent cover). Next in the middle is red, which indicates moderate cover (40-60 percent cover). On the top is green, which denotes high canopy cover (greater than 60 percent cover). Across the bottom, the acres for each combination of canopy cover (rows) and diameter size class (columns) are shown.

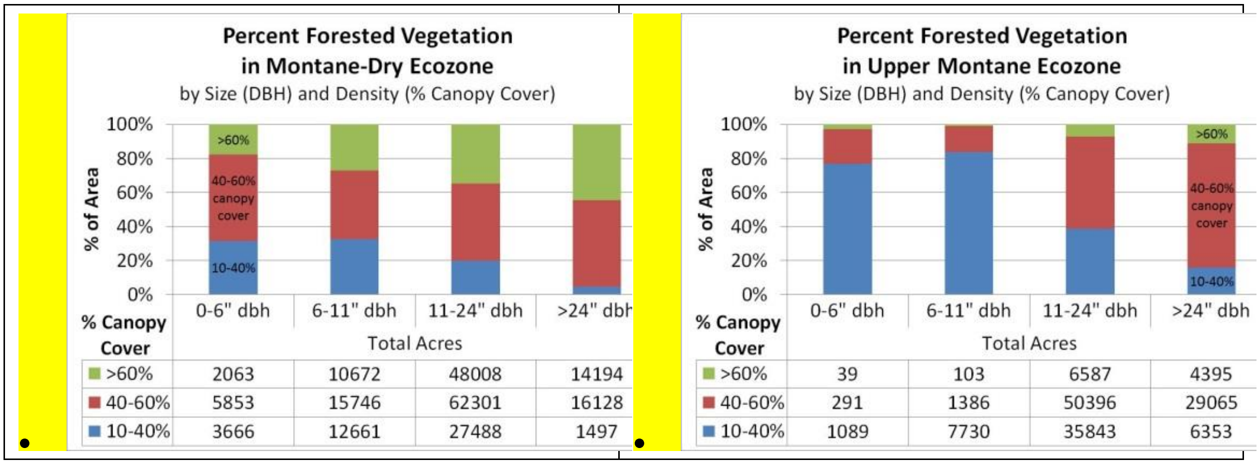
The top left stacked bar graph is of the forested vegetation in the foothills zone. Over three-quarters of the area are pole and small diameter trees. Areas are close to evenly divided between open, moderate, and dense canopied pole forests. Stands of small diameter trees are mostly dense or moderate canopied with less than 10 percent in open canopies. This pattern is further magnified in the large diameter tree stands, with less than 5 percent in open canopy forests, and nearly 60 percent dense canopied stands. The top right graph shows pinyon-juniper/sagebrush areas. It occupies a relatively small portion of the assessment area, and most of it is again in pole and small sized trees. In contrast to the foothill areas, most of it is in very open canopy (10-40 percent cover). But about one-quarter of the patches have moderate canopy cover (40-60 percent). The lower right graph is of upper montane forests, comprised of red fir, white fir, Jeffrey pine, and some lodgepole pine stands. Patterns are similar to pinyon-juniper with canopy cover mostly open or moderate. However, at least one-third of the stands are in the large tree size class. In these, almost 80 percent are in moderate canopy cover. Many of these stands are old growth or have a significant old growth forest component. On the lower left, the structure of montane forests is displayed. Most of the area is in small diameter trees (11-24 inches diameter), followed by pole and then large diameter tree stands. Canopy cover is mostly moderate to high except for the pole-sized stands, where it is equally open canopied.



% Canopy Cover	0-6" dbh	6-11" dbh	11-24" dbh	>24" dbh
	Total Acres			
>60%	42	7246	7300	523
40-60%	172	9999	11256	317
10-40%	346	9480	2354	51



% Canopy Cover	0-6" dbh	6-11" dbh	11-24" dbh	>24" dbh
	Total Acres			
>60%	0	94	1572	1356
40-60%	2	1600	15087	1175
10-40%	615	9937	15278	399



Forest vegetation size/density for foothill, montane-dry, upper montane and sagebrush/pinyon-juniper zones on the Sequoia National Forest

Vegetation Diversity: Large Trees and Snags

Large trees and snags are important to numerous cavity nesting and foraging animals including fisher, marten, California spotted owl, woodpeckers, flying squirrels, great gray owls, and many cavity nesting birds.

Large tree density varies considerably by forest type. High elevation red fir, lodgepole pine and Jeffrey pine forests have relatively high mean or median densities. Trees greater than 30 inches in diameter are generally four trees per acre or more. The coefficient of variation (COV), a measure of how variable those numbers are is 122 percent. This means that the densities vary radically across the landscape. Although mean or median levels are moderate in these forest types, the coefficients of variation are often high. Mixed conifer forests have moderate but highly variable densities of trees greater than 30 inch diameter (median 4.5 trees per acre, COV 95 percent) but trees greater than 40 inch diameter are sparse (median 0.8 trees per acre). These forests occur on more productive sites and trees greater than 40 inches in diameter were once more common. In ponderosa pine dominated forests, large trees (diameter greater than 30 inches) are less common and highly variable in occurrence, with mean and median densities of 2.8 and 2.0 trees per acre respectively. Hardwood-conifer and hardwood forests have relatively high densities of trees greater than 21 inch diameter (2 to 18 trees per acre) but the levels are highly variable in the mixed hardwood-conifer forests.

Densities of snags greater than 15 inches follow similar patterns by forest type but with levels at least 100 percent lower. Lower levels of snags would be expected. It is not known how these levels compare with historic levels prior to fire suppression and European settlement.

For more detailed information see the August 2, 2013 snapshot of the Sequoia National Forest Living Assessment Chapter 1, lines 544-564.

Vegetation Diversity: Within Stand Structure

Heterogeneity is a term used to describe variable or patchy vegetation. North (2012) and others consider restoration of forest heterogeneity a major management goal. Previous discussion of increased forest density and lower large tree levels support the research that forests have become more uniform (North et al. 2009). This includes studies on the nearby Sierra National Forest (North et al. 2007). North and Sherlock (2012) suggest using the coefficient of variation of stand structures as a way to measure the amount of "heterogeneity". Using the FIA data, the variation in basal area - the total cross-sectional area at 4.5 foot height of all trees - was calculated on the Sequoia National Forest. Each plot consisted of four subplots. Almost all of the forest plots had coefficients of variation less than 100 percent, meaning they had low within-stand variation. The exceptions were a small proportion of the blue oak woodland and montane hardwood plots. A small number of plots in these vegetation types had variation greater than 100 percent.

For more detailed information see the August 2, 2013 snapshot of the Sequoia National Forest Living Assessment Chapter 1, line 543.

Special Habitats

There are some habitats that are less common, yet support a high level or specialized type of biodiversity. Information is limited on these habitats, but they are important to include. While not an exhaustive list, some of the special habitats noted on the Sequoia National Forest include old forest, complex early seral forest, rock outcrops, and giant sequoia groves. The ecology and the characteristics of giant sequoia groves are addressed in the recent Giant Sequoia National Monument Plan.

Rock outcrops support a variety of uncommon and often rare plants. These include marble, gabbro, and granite rock outcrops. Plants associated with these habitats are described in Chapter 5 of this assessment. These areas are impacted by invasive plant species, habitat fragmentation, uncharacteristically frequent fire, surface mining, post-fire disturbance, illegal marijuana cultivation, and climate change.

Early seral vegetation includes areas where the vegetation is relatively young. In forests, this often means that instead of trees, sites are dominated by shrubs, herbs and grasses. Complex early seral forests contain residual legacies from previous older forests, such as large snags and logs. Information pertaining to the proportion of complex early seral forest is lacking for the Sequoia National Forest, including the natural range of variability. It is likely that with the extensive areas of fire restoration in the Kern Plateau, there are well distributed small and moderate-sized patches of this habitat type. Several ecological, post-fire assessments have documented some of this information (Fites-Kaufman et al. 2005, Valliant 2009, Ewell et al. 2012). Large snags, large live trees and shrubs are the most common nesting habitat used by birds in the bio-region. A comprehensive map of complex early seral forests is not available. There is no comprehensive vegetation map that includes large snags and logs.

For more detailed information see the July 18, 2013 snapshot of the Bio-Regional Living Assessment Chapter 1, lines 976-1538.

Terrestrial Animal Diversity

The Sequoia National Forest is inhabited by approximately 304species of terrestrial wildlife: 194 bird species, 85 mammal species and 25 reptile species. There are also 13 amphibian species, some of which are terrestrial for at least part of their lifecycle. Chapter 5 of this assessment contains detailed information on species classified as federal threatened, endangered, proposed or candidate species under the Endangered

Species Act. Species of conservation concern, their habitat, threats, condition, and trends are also covered in Chapter 5 of this assessment.

Connectivity

The ability for species to move throughout a landscape is important for ecological integrity. Species that are wide-ranging are able to maintain genetic diversity and sustainability in the face of changes to their population or environment. Connected landscapes allow other species to migrate in the face of climate change or other pressures. Existing information on connectivity across the Sequoia National Forest and the bio-region include: California "essential connectivity project corridors"; the fisher and marten habitat connectivity assessment (Spencer et al. 2011); special management areas; old forest emphasis areas from the Sierra Nevada Ecosystem Project (SNEP) (Franklin and Fites-Kaufman 1996); and distribution of multiple old forest habitat associated species in relation to landscape fire resilience.

The Sequoia National Forest contributes greatly to connectivity in the bio-region in several ways. One of the most important is the north-south oriented canyons and mountains across most of the forest because it allows for northward movement. This will become increasingly important with climate change. The unusual combinations of plants from different surrounding bio-regions are evidence that northward migration has happened in the past. Plants from the south can readily migrate north through the Kern River Canyon. At the higher elevations on either side, there is connectivity to areas to the north in wilderness or other specially designated areas such as the Giant Sequoia National Monument. The areas immediately to the north on Sequoia and Kings Canyon National Parks, the Sierra National Forest and the western portion of the Inyo National Forest are unique in the bio-region in having no road that crosses the crest. Wilderness areas on the east side of the Sequoia National Forest connect with this large block.

The distribution and connectivity of habitat used by fisher on or near the Kern Plateau may become particularly important in the future with climate change. Currently, there is limited information on fisher habitat use in these types of areas, preventing a specific habitat model for these drier areas (Spencer 2012). In this area, fisher are thought to be more widely distributed but successfully reproducing in a more open forested habitat than typical in the rest of its distribution on the western slopes of the Sierra Nevada. These forests occur in a climate more similar to what will occur in other areas that are now wetter in the future – one that is hotter and drier. Climate projections suggest that the Kern Plateau may be at relatively lower climate exposure than other parts of the Sequoia National Forest (Schwartz et al. 2013a).

In the assessment area to the west of the Kern River, there is north-south connectivity as well as a position adjacent to the Giant Sequoia National Monument. This situation will change as vegetation becomes dense, fuels accumulate and climate warms, and fires increase in frequency and intensity. While lightning-caused fires are part of the natural ecosystem, past suppression policies have led to conditions that can result in large areas of high severity effects that may be detrimental to old forest species such as the fisher or California spotted owl. There is some uncertainty about the effects of fire severity on these species (Keane 2013 and Zielinski 2013). Modeling has suggested that large, high severity fires have significant, negative impacts on fisher habitat quality and population size (Scheller et al. 2011, Thomson et al. 2011). There are two studies that are in progress on the use of burned areas by fisher (Hansen 2013).

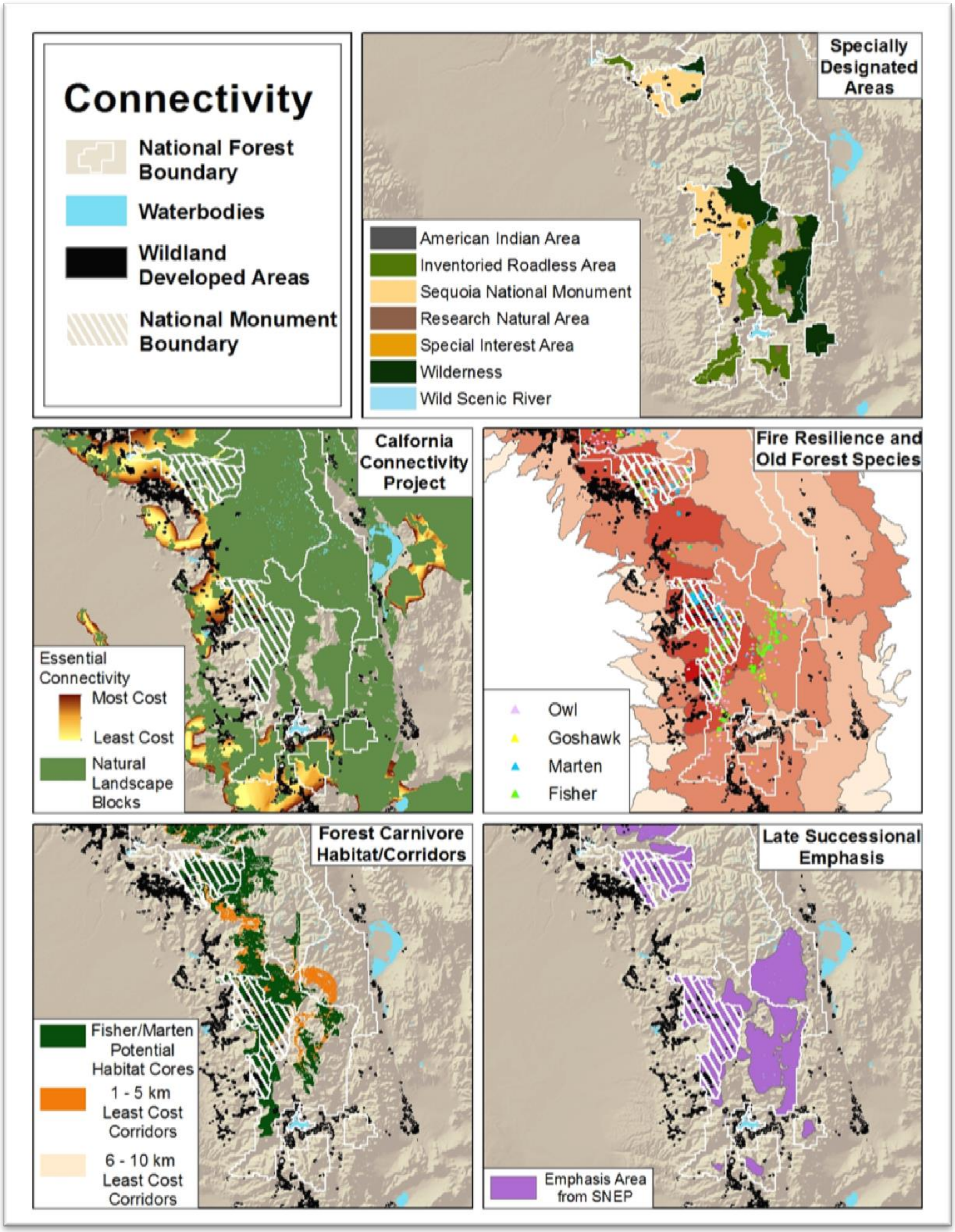
In addition, California spotted owls may occupy burned forest landscapes but primarily following low to moderate severity fires (Roberts and North 2011). This includes both nest and roost sites. One study in a single high severity burned patch of the McNalley fire (2002) showed that California spotted owls foraged at higher frequency in high severity burned areas. However, results of this study were limited (four territories) in a single high severity burned patch (Bond et al. 2009). Nesting habitat was not evaluated and may be more limiting for the California spotted owl in the Sierra (Verner 1999, Keane 2013). Finally, although the Breckenridge, Piute, and Scodie Mountains occur as "islands" surrounded by a "sea" of low elevation area, they provide important potential refuge for mid and higher elevation species as climate warms and dries. It is possible that they could provide some refuge for northward migrating species responding to warming climate in the mountains of southern California.

The figure below shows five panels displaying key sources of information on connectivity. Each panel displays the Sequoia National Forest. The boundary is depicted with a white line. The surrounding areas are draped over a topographically shaded relief map of the landscape.

On the top left panel is a legend with the following common map features: wildland developed areas, or where there are structures or infrastructure as large black dots; large water bodies are colored light blue; and major roads as thin purple lines. The top right map is of special management areas. These are where management is limited and include: dark green for wilderness, occupying the eastern one quarter of the forest as a linear strip running north to south; adjacent to that in a strip to the west is an undesignated, roaded area; then to the west are inventoried roadless areas shown as moss green including half of the Piute mountains in the far south and the Breckenridge mountains in the far southwest; diagonal white lines for the Giant Sequoia National Monument; and widely scattered, small patches shown as brown or rust that represent research natural or special interest areas. Several long stretches of wild and scenic rivers are shown in light blue, extending primarily in or next to wilderness and roadless areas.

The second row is from the California Connectivity Project on the left, and on the right are the locations of old-forest species (California spotted owl, goshawk, marten, and fisher) over landscape fire resilience index ratings. Most of these areas overlap with areas of low resilience to high intensity fire, except for the far eastern area overlapping with the wilderness areas. See Chapter 3 of this assessment for further discussion of fire resilience. On the Sequoia National Forest, the California Connectivity Project overlaps with wilderness and inventoried roadless areas. The exception is on the south end of the forest, where a large swath between the foothills and higher elevation was designated as a safe area for moving between habitats. The least cost (yellow) equates to the lowest risk to the animals. The California Connectivity project identifies the lands between the Breckenridge and Piute Mountains, mostly private, urbanized land, as a key connecting area between these two blocks managed by the Forest Service.

The two maps on the third row display the forest carnivore habitat and corridors on the left and late successional emphasis areas (Sierra Nevada Ecosystem Project Report to Congress in 1996) on the right. Outside of the Giant Sequoia National Monument, there are limited areas identified as forest carnivore habitat or corridors. Safe (least cost) corridors are in orange and pink and fisher/marten habitats are marked in dark green. These primarily occur to the northeast of the Giant Sequoia National Monument, connecting to the Sequoia and Kings Canyon National Parks, depicted as a large green block. The other forest carnivore area is shown as a series of north-south large patches to the east of the Kern River in the mostly roaded area between the Kern Plateau wilderness areas and the roadless areas to the west. These connect with a large corridor area across the southwest portion of the Inyo National Forest to the north to the large green patch north of the Giant Sequoia National Monument. The patches are not readily evident as being continuous but rather look like splotches, irregularly placed. Finally, the late successional emphasis areas, identified in the report to Congress in 1996 (Franklin and Fites-Kaufman 1996) occur as large purple patches covering most of the Giant Sequoia National Monument, and most of the rest of the forest to the north of the lower Kern River Canyon in the south. There are small patches at the highest elevations in the Scodie and Piute Mountains in the far south.



Connectivity on the Sequoia National Forest

Overall, connectivity of old-forest associated species is high, but vulnerable to uniform, high intensity fire during more severe weather conditions. Weather conditions conducive to intense fire are already increasing with climate change and are expected to increase more in the near and distant future. Connectivity of early seral habitat, particularly complex early seral habitat is unknown but likely limited due to fire suppression and past forest management.

For more detailed information see the July 18, 2013 snapshot of the Bio-Regional Living Assessment Chapter 1, lines 1539-2042.

Fire as an Ecological Process

Fire is a "keystone" ecosystem process in the bio-region and on the Sequoia National Forest (McKelvey et al. 1996, van Wagtendonk and Fites-Kaufman 2006). This means that it is of key importance to ecosystem composition, structure, and function. Fire shaped the ecosystems. The patterns and history of fire on the Sequoia National Forest and in the bio-region are discussed in Chapter 3 of this assessment.

Recurrent fire has shaped ecosystems of the Sierra Nevada (Skinner and Chang 1996). Many of the plants have fire adapted or enhanced traits, such as sprouting, thick bark, fire-stimulated flowering, or seed release or germination (Chang 1996, van Wagtendonk and Fites-Kaufman 2006). Many of these have been reduced in density or health. A notable example is black oak. It sprouts following fire, and seedlings are resistant to low intensity fire. Currently, there are concerns about negative impacts of dense conifer cover around them, reducing their vigor, extent, and reproduction (USFS 2001). They readily form cavities and can be important for many species. Highly variable fires maintained patchy or "heterogeneous" vegetation structure and composition (North et al. 2009). This patchiness, along with enhanced plant growth from sprouting or fire-induced nutrient flushes, is thought to have provided diverse and productive habitat for many different plant and animal species. Animals currently associated with high density canopy, such as fisher or California spotted owl, may have previously been associated with more diverse vegetation that supported more prey, as well as cover. With fire suppression, this diversity has decreased. It is unknown how species would change with increased vegetation diversity (Keane 2013, Zielinski 2013).

There are some prominent plant species that depend on fire in different ways on the Sequoia National Forest. For example, as in southern California, there is a rich array of annual flowering plants that only emerge and flower following fire, particularly in small patches of higher severity fire (Keeley et al. 2003). A recent study in the nearby Sequoia and Kings Canyon National Parks found that twice as many flowering plants were found in burned areas (Webster and Halpern 2010). The Piute Cypress, a local endemic tree, is another example. It occurs in the southernmost areas of the forest. It has serotinous cones that only open following heat from fire. The seeds are trapped otherwise and cannot germinate.

The photo below shows a dense stand of even-aged Piute Cypress. Only a sea of dark, olive green, spire shaped tops can be seen. The trees are closely spaced, with crowns overlapping and are all 80 years old. They all germinated and grew after a stand-replacing fire.

Piute Cypress stand

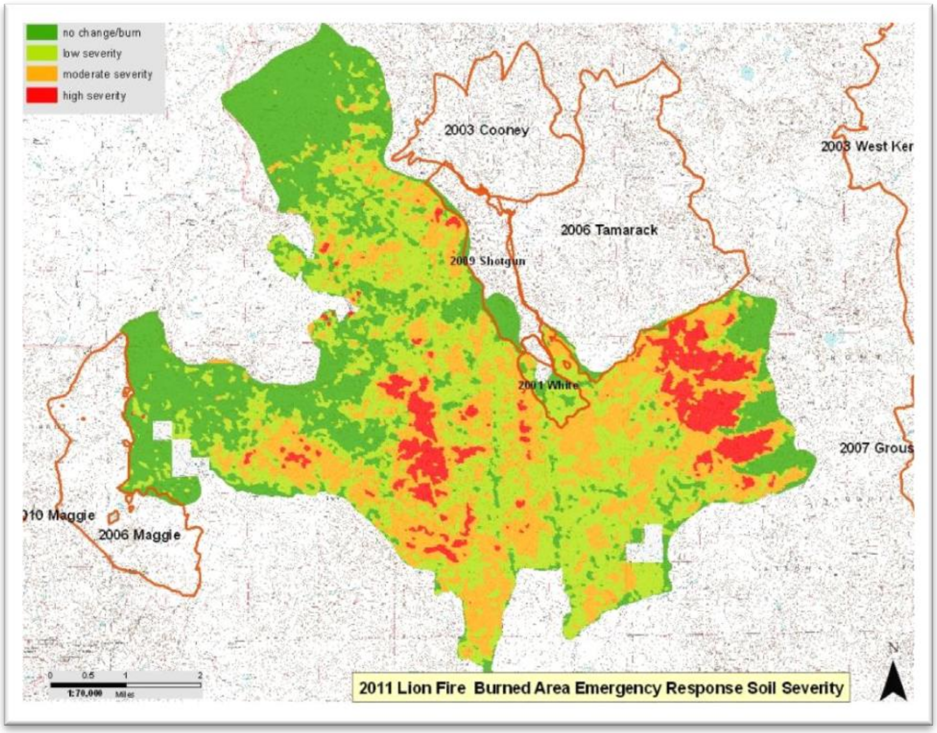
One of the most debated aspects of fire effects is fire severity. The Sequoia National Forest is a "hotspot" for these debates because of the number of recent fires with different sizes, intensities and locations that overlap with species of concern including the fisher, marten, California spotted owl, and black-backed woodpecker.

Fire severity is a reflection about the impact of a fire on a given plant or plant community. If a plant is killed, it is a high severity effect on that individual. More importantly than individual plants is the impact on the suite of plants in an area, or the "plant community". If most or all of them are killed, that is considered high severity. If only a few are killed, that is referred to as low severity. There are different ways to measure and characterize fire severity, including surveys on the ground using detailed plots or visual indices, to satellite imagery interpretation. Aspects often interpreted differently are what to measure and how and what it means ecologically. There is no one right approach. What and where it comes from and what it means depends on the place, scale, and element of biodiversity in question.

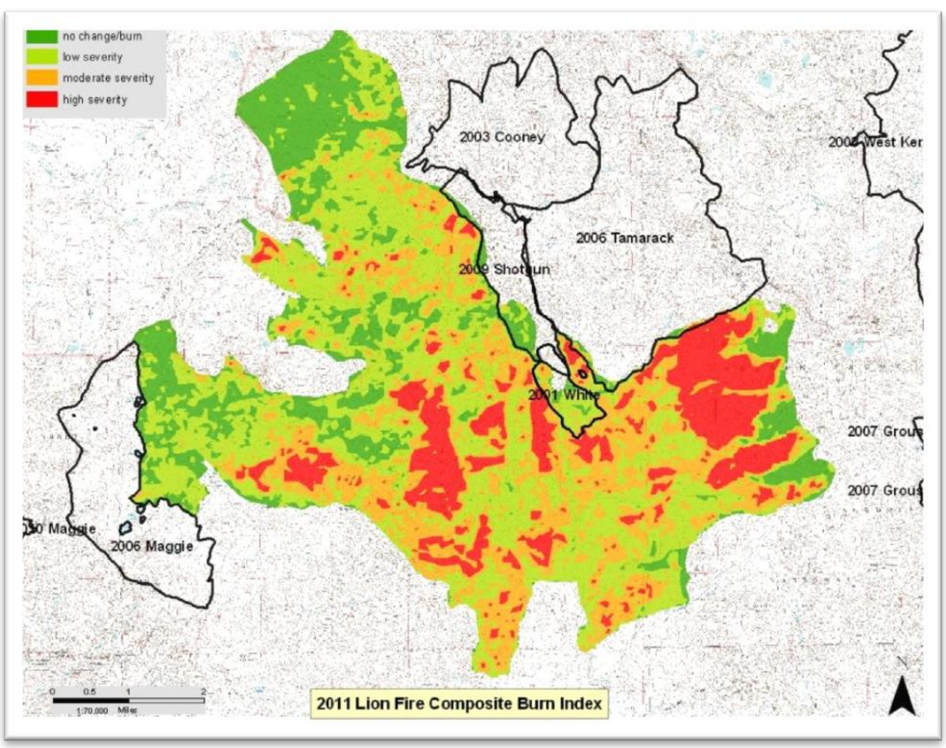
These questions particularly come up when comparing the amount and patch size of high severity fire using satellite-based maps created immediately after a fire for burned area rehabilitation (BAER) and one-year post fire for ecological monitoring (Composite Burn Index—CBI).

The maps below contrast fire severity estimates by major vegetation type in the Lion Fire (Ewell et al. 2012). In 2011, the Lion Fire burned primarily in the Golden Trout Wilderness. Both maps are based on remote sensing imagery from LANDSAT satellite and is classified into unburned (kelly green), low severity (yellow green), moderate severity (light orange), and high severity (red). Severity reflects how much vegetation is burned or how much soil cover is burned (charred or changed to ash). The BAER severity index is produced immediately after the fire, and is an indication of fire effects to soil rather than vegetation. At this time, the satellite primarily detects reflectance off of the soil and the color of ash. The emphasis of the BAER severity index is on assessing soil effects and needs for remediation or rehabilitation to reduce potential soil erosion. Similarly, the composite burn severity index (CBI) is based on the same type of satellite data from images taken one year after the fire. This is to allow plants to re-sprout or re-seed following the fire. It can also take up to a year for some trees to die after a fire, since they can live off stored energy. This is called the composite burn index, and it primarily reflects the effects of fire on vegetation. Both indices are valuable, but it can be difficult to compare them directly since they indicate different types of fire effects.

In the maps below, the fire perimeter is shown as an irregular shape, almost like a maple leaf, with three large lobes extending northwest, north, and northeast. In both maps, there are large areas of no burn at the ends of the lobes. Similarly, in both maps there are large diagonal patches of high severity (red) throughout the upper half of the northeastern lobe. These high severity patches are mostly one mile in length and approximately half to three-quarter mile across. These were days where the fire made significant runs. In the remainder of the fire areas, there are mosaics of a complex pattern of various sized patches of mostly high severity (red) and moderate severity (orange). In between the matrix is almost entirely low severity (yellow green). Surrounding the Lion Fire perimeter, black lines outline adjacent recent fires including the Cooney, Shotgun, and Tamack Fires to the north, and the Maggie Fire to the southwest. When the Lion Fire reached these areas, it mostly stopped or did not go far, except in the small White Fire area, which occurred ten years prior. The other fires were more recent, mostly since 2006.



Lion Fire BAER map

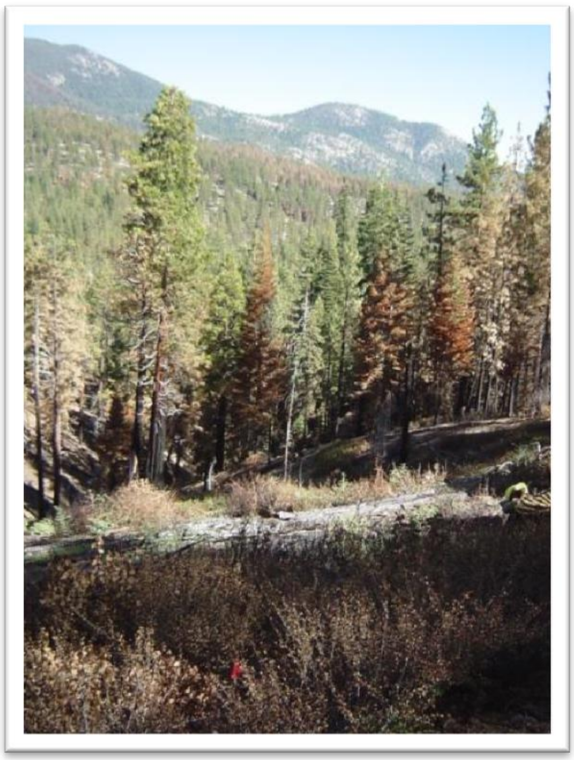


Lion Fire Composite Burn Index

These differences result mostly in varying estimates of high, moderate, and low severity fire. For example, in the BAER map, less than 10 percent of the mixed conifer and red fir forest and chaparral types are shown as high severity but in the CBI map, nearly 20 percent of each.

The following two photos below show different locations in the Lion Fire.

This photo shows where the fire crossed into the previously burned white fire area. The photo shows a mixed conifer forest of pine and fire with little scorching on the trees. The trees are mature. Some taller trees have no scorch. Some trees have scorch up to two-thirds of the crown. The scorched needles are red, indicating relatively low fire intensities. In the foreground are tan, scorched shrubs.



White and Lion Overlap (unburned and low severity)

This photo shows where the fire crossed into an unburned area. The photo shows a forest that burned at high intensity with few needles remaining in the trees. They primarily have black-charred boles and branches. There is no vegetation evident in the foreground on the forest floor.

Lion only, near but not in White Fir (moderate and high severity)

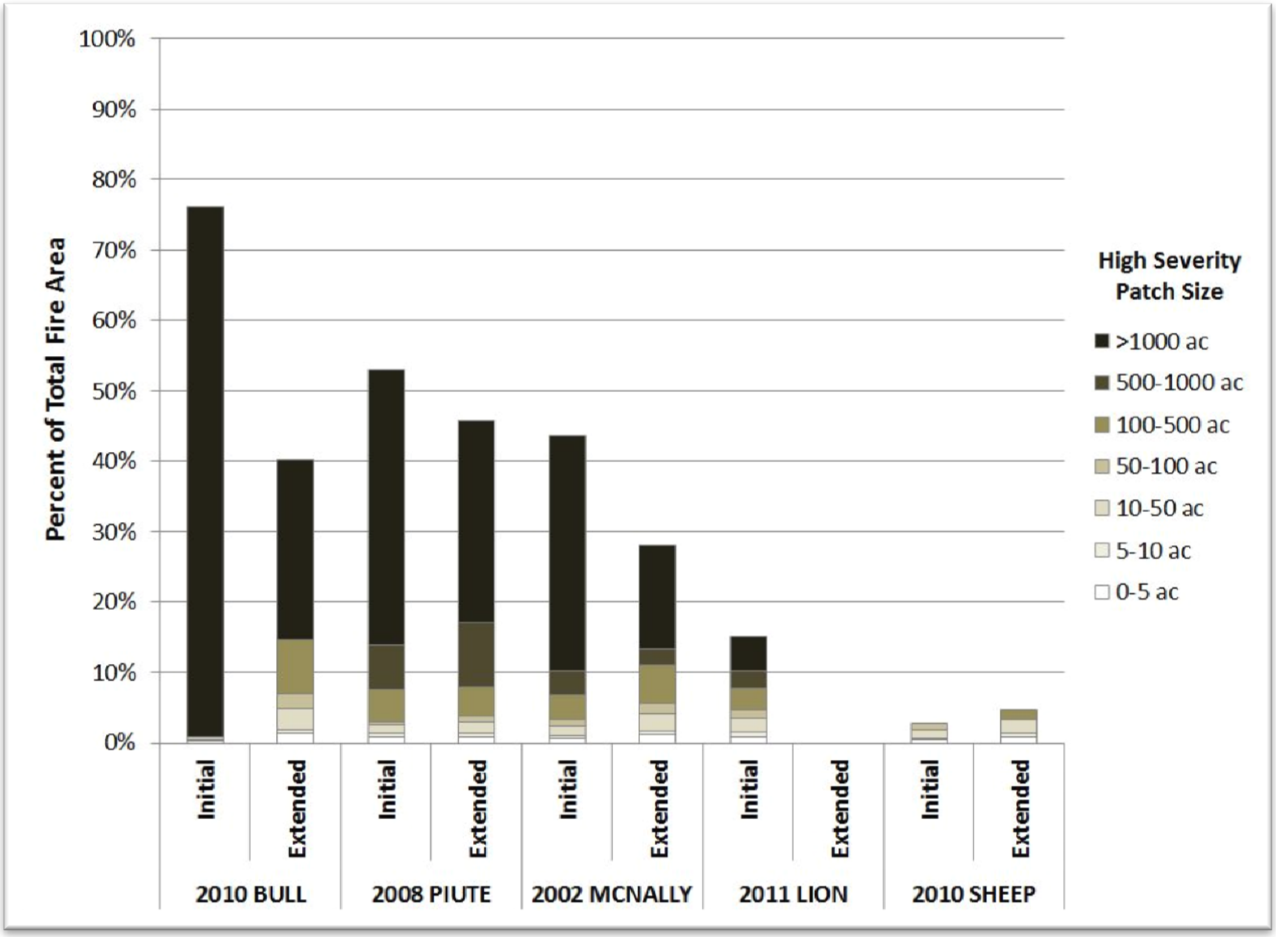
These contrasting images show the effect of fires burning into other areas that have burned recently in a landscape where extensive fire has been restored.

The way the Lion Fire burned into and stopped or decreased in severity when reaching nearby burned areas illustrates one of the most important ecological effects of fire at the landscape scale. That is to keep vegetation, or fuels, variable and at lower levels (i.e. within the natural range of variability). This means that when fires do burn, even under more severe weather conditions, they burn less intensely.

One way to consider the change is through estimates of “fire deficits”. This can be characterized as the number of fire cycles missed. Van de Water and Safford (2011) computed a fire return interval deficit that is shown and described in Chapter 3 of this assessment. Most of the landscape has had a high departure in the frequency of fire compared to historic reconstructions. Another way is to depict the time since last fire. This has not been completed at this time. There have been some active efforts to restore fire or some of the effects of fire through other vegetation management, but the pace and scale of those efforts is limited by several factors including regulatory and institutional barriers (North et al. 2012). See Chapter 3 of this assessment for more detail.

Looking at fire from a natural range of variability lens is useful for ecological integrity; however there are many ecosystems in the Sierra Nevada where restoration of fire or vegetation conditions that were present when fire was more frequent is not feasible. Further, there are many uncertainties about how to characterize or interpret different sources of scientific information on historic high severity fire. Additionally, the ecological impact of high severity fire may be greater now than in the past, because some ecological elements, such as old growth forest, or habitat for rare species are limited. High severity fire in these more limited ecological elements has more impact, even if it is within the range of what occurred historically. This creates a need for a scientific basis to determine the level and extent of high severity fire that impacts rare species or habitats or species of concern, such as the California spotted owl. The question becomes how much high severity fire is too much. Additionally, there are social factors, including determining how much high severity fire society as a whole is willing to accept. The massive Rim Fire on the Stanislaus National Forest and Yosemite National Park is an example of a situation where these questions could be addressed. In order to inform this discussion for the next phase of forest plan revision, an assessment of the pattern of high severity fire across a range of fires on the Sequoia National Fire was conducted.

In the graph below the percent of the total fire area that burned at high severity (y-axis) is shown for a variety of fires on the Sequoia National Forest. This is according to the Composite Burn Index maps. Across the x-axis, two paired bars represent maps from five different fires. In each pair, on the left, there is a map that was developed immediately after the fire and on the right, one that was developed one-year post-fire (extended). Fires are arranged in general order from those that had more high severity fire on the left (Bull, Piute, McNalley) and less high severity fire on the right (Lion and Sheep). Within each bar, the proportion of area in different size patches is shown (greater than 1,000, 500-100, 100-500, 50-100, 10-50, 5-10, and less than 5 acres). The Bull, Piute, and McNalley Fires all had more than 50 percent high severity in the initial fire severity maps. The majority of these were in patches greater than 1,000 acres in size. In contrast, the Lion Fire had about 15 percent and the Sheep fire less than 5 percent high severity patches. The higher severity fires were wildfires solely managed to meet protection objectives and the Lion and Sheep Fires were wildfires managed primarily to meet resource benefits. This means that fire managers carefully considered weather conditions and how dry fuels were, along with location and ability to manage before allowing them to burn for resource benefit. Currently, a fire risk analysis is underway to better characterize the weather conditions and potential resource effects needed to support wildfires managed primarily to meet resource benefits.



Graph of percent of total fire area that burned at high severity for Bull, Piute, McNally, Lion and Sheep Fires

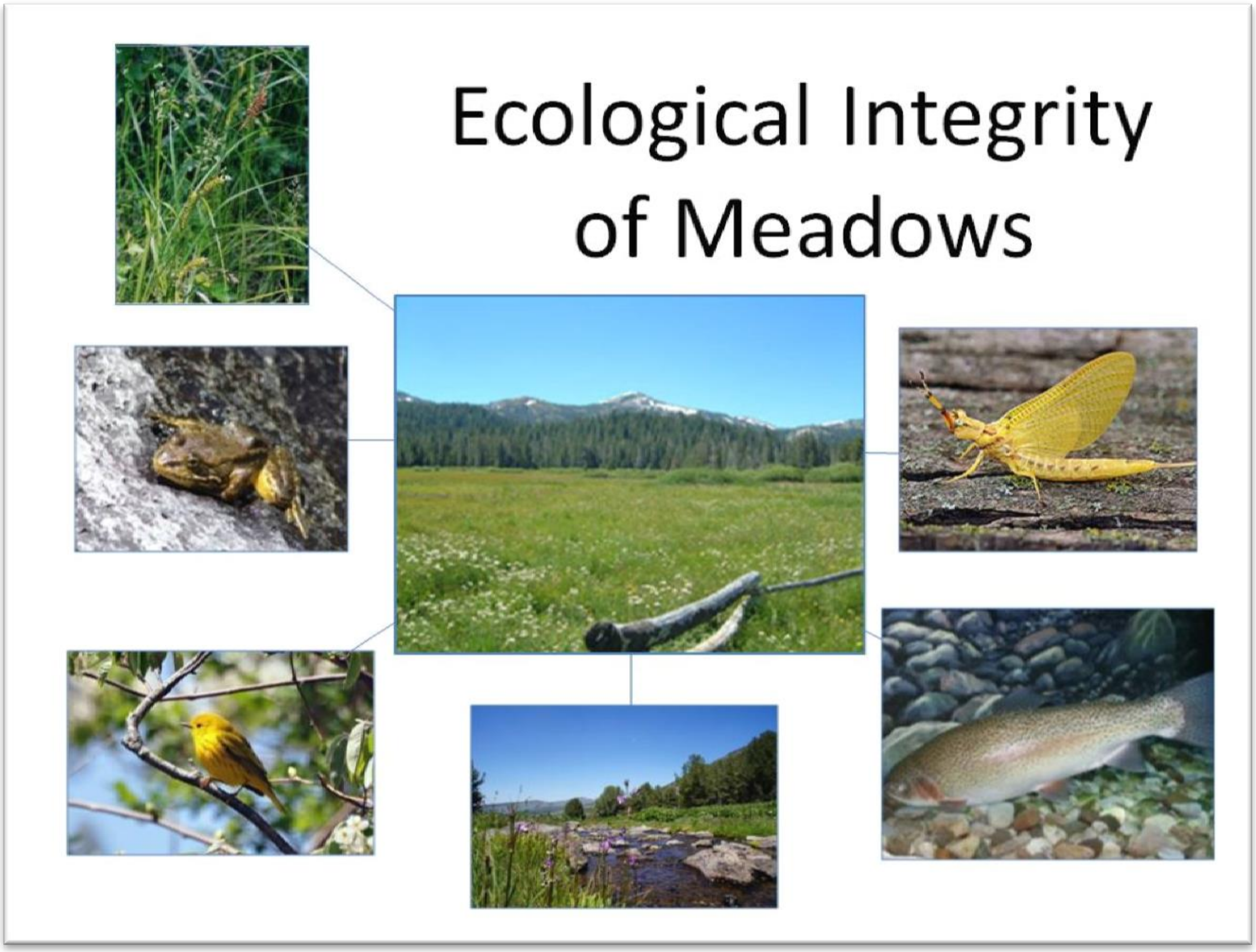
More detailed information can be found in the July 18, 2013 snapshot of the Bio-Regional Living Assessment Chapter 3, lines 957-1013.

Aquatic and Riparian Ecosystems

Water-based ecosystems—aquatic and riparian based ecosystems in the water-land interface—are closely linked. Water moves between them. Insects and frogs move between them. Riparian plants are influenced by levels and timing of water in the aquatic ecosystems. Aquatic ecosystems are affected by shade from riparian plants and nutrients from the leaves that fall into water. These strong connections make it difficult to separate the ecological integrity of aquatic ecosystems from riparian ecosystems. Yet, each has unique features.

There are three types of aquatic/riparian ecosystems: lakes or ponds, streams or rivers, and seeps or springs. Each one of these has water surrounded by vegetation that is dependent on water. With streams or rivers, there is a further distinction with those surrounded by meadows and those surrounded by narrow strips of shrubs, trees, or non-meadow vegetation. Many of the riparian areas across the forest are steep or narrow with pines, oaks, or giant sequoias along the banks. On the Sequoia National Forest and across the bio-region, the focus has been on the ecological integrity of meadow/aquatic ecosystems due to their limited distribution and importance in a dry climate.. These ecosystems have been especially impacted by historic management such as road locations and intensive grazing during the 1800s and early 1900s. These ecosystems are prized for scenic value for recreation, are used for more carefully managed grazing, and are habitat for a large number of species, including a number of rare, threatened, and endangered animals.

The figure below illustrates the linkages between ecological elements of riparian and aquatic ecosystems in meadows. In the center of the figure, a wet meadow is shown. The foreground has a dense carpet of lush, green sedges and scattered white wildflowers. The background shows a low ridge with forest and a snow-covered mountain peak behind it. Surrounding this photo are the some of the inhabitants of a meadow. Going clockwise, starting on the right is a bright yellow-aquatic insect, an adult mayfly, which lives in the riparian area as an adult and in water when immature. Next, a rainbow trout is over a bed of gravel in a stream. The trout depends on insects like the mayfly. Next, a stream channel, the meadow and other riparian vegetation is dependent on subsurface water that feeds the stream but also water that floods over the banks of the stream into the meadow at times. When the channel drops down, or is “incised” it reduces the water source for the meadow and can disrupt habitat for all riparian species. To the left is a photograph of a bright yellow little bird, the yellow warbler. These birds eat insects that spend part of their life in the water, and use shrubs, that grow in the wettest parts of meadows for nesting and raising their young. They also use the shrubs to hide from predators. Above the bird is a photograph of a frog. Most frogs start as eggs in water and then move to adjacent riparian areas once they grow legs. They depend mainly on insects in water and riparian vegetation. Finally, above the picture of the frog, is a close-up of sedge and grass plants. These form the basis of the food chain for meadow ecosystems. Meadows are comprised of specific grasses and sedges that need water. Not only do they provide food for insects or voles or deer, but they also are important in providing soil and streambank stability with their dense network of roots.



Ecological integrity

There are many factors that affect the ecological integrity of aquatic and riparian ecosystems. These include European settlement, invasive species, early grazing, roads, recreational use, fire history and especially climate. Since aquatic and riparian ecosystems are so tied to water, fluctuations in rain and snow are particularly important to their ecological function. There are many different sources of information and viewpoints about grazing in meadows and how it affects the ecological integrity of these ecosystems (e.g. Menke et al. 1996, Long et al. 2013). This topic is contentious because most research and monitoring addresses one or several ecological characteristics, such as vegetation and soils, or aquatic insects and water, or frogs and habitat (Purdy et al. 2012). In addition, very little research has provided context on the type of grazing system used (Briske et al. 2011, Long et al. 2013). The Forest Service is also grappling with these issues in its monitoring and assessments.

Aquatic Ecosystems

Rivers and Streams: Natural Range of Variability for Season and Inter-annual, Decadal Water Flow Patterns

The three rivers that produce the most water from the Sequoia National Forest, the Kern, the Tule and the White River produce approximately 835,000 acre feet of water per year on average. The El Nino Southern Oscillation is partially responsible for approximately a decade long inter-annual precipitation pattern in the southern Sierra Nevada. Drought years alternate with normal and extremely wet years during these decade long oscillations. In recent years, the pattern has increased in variability. Within the same year, the Mediterranean climate may have long dry summer periods and highly seasonal winter precipitation. The natural variability in flows makes it difficult to detect departure from the natural range in variability for the quantity of water flowing from the forest. Trend in the quantity of water is difficult to detect due to the natural variability across the forest from year to year. In the past, the snowpack stored part of the winter precipitation into the drier summer months. A well-documented shift toward earlier runoff in recent decades has been attributed to a decreasing trend in snow precipitation and earlier snowmelt (Hunsaker 2013). The rain-snow interface zone is predicted to occur at higher elevations, causing warming of streams earlier in the season.

Aquatic Animal Diversity

The Sequoia National Forest was occupied by at least nine known native fish species prior to 1850. On the Kern River, trout occur naturally in high elevation areas. On other river systems across the forest, fish were not native to many of the streams above 3,000-5,000 feet. Stocked or self-sustaining populations of hatchery rainbows, nonnative trout: nonnative bass and sunfish occur in the rivers and streams, A number of other non-native fish occur in the Kern River below Lake Isabella, but whether these are self-sustaining populations is unknown. Of the native fish, the little Kern golden trout is threatened, and 4 are listed as Forest Service species of conservation concern. See Chapter 5 of this assessment for more detail. The projected impacts of warming temperatures from climate change on trout and salmon species are a concern because of their vulnerability to increased stream temperatures and changes in flows. On the Sequoia National Forest, native trout are currently restricted to a few small tributaries in upper elevations areas.

By the mid-1990s, both frogs and salamanders native to the forest were in need of some type of protection. One native frog is a candidate for federal listing as endangered and six others are species of conservation concern for the Forest Service. The declines of some amphibian species came with the introduction of fish into previously fishless areas. This predator disrupted connectivity of habitat for frog species. Recently air and water pollution, fish, non-native bullfrogs and Chytrid fungus have been implicated in the decline of these species. Historically, the slender salamander species were found throughout the forest. However, the range for each species is highly restricted and within these ranges the salamanders occur in isolated colonies. Data is not available on the number of occurrences of these species or how many populations are on the forest. Western Pond turtles were found throughout the lower elevations of the southern Sierra Nevada. However, surveys indicate a declining trend.

Due to the steep mountains and isolated seeps and meadows, many aquatic invertebrates are endemic to the Sierra Nevada. Aquatic invertebrates are affected by excess sediment, changes in hydrology and other changes in the watershed due to altered land use patterns (Herbst et al. 2012). Changes in a food source of such importance as aquatic invertebrates can have repercussions in many parts of the food web. Introduction of non-native fish to lake and streams has reduced numbers of species and increased losses of endemics and native montane species. However, detailed studies of aquatic invertebrates in high elevation areas and springs have not been conducted in the last 20 years.

The Sequoia National Forest has only a few lakes and all of them are in wilderness. These are Maggie Lakes, Weaver Lake, Silver Lake and Coyote Lake. Some lakes, such as Silver Lake, have remained with no introduced fish. These lakes provide a last refuge for the Mountain yellow-legged frog. In previously fishless lakes, the effects of introduced fish caused the loss of frogs from the area. In addition, air pollution from the Central Valley or metropolitan areas may influence water chemistry.

There are an estimated 556 meadows on the Sequoia National Forest. Fens are continually wet areas where soils rich in organic material form. Meadows, seeps and springs in the drier southern Sierra Nevada Mountains provide important habitat diversity and habitat for plants and animals. Currently, biodiversity indicators such as fish and amphibians indicate some meadows are not in good condition (Moyle and Randall 1998, Purdy et al. 2012, Viers and Rheinheimer 2011, Vredenburg, et al. 2007, Pacific Rivers Council 2012, USFWS 2013a and b). Meadows, seeps and fens are dependent on snowpack to sustain the water throughout the long dry period of summer. There is little information about the current trends for springs. As the rain-snow interface changes, lower elevation meadows and fens will be increasingly at risk. Restoration of these systems holds great potential to provide multiple ecological and social benefits, despite their small share of the landscape. Evaluating the role of natural processes such as wildfire and management practices such as grazing, on a larger, watershed scale, could aid the design of more effective strategies to promote long term resilience of these valuable systems.

Connectivity: Rivers, Streams, Reservoirs

Dam and diversions contribute to aquatic habitat alteration by blocking fish movement or migration, and contribute to species isolation. Major dams and their reservoirs are found just off the forest on the Kings, Tule and Kern Rivers and block the movement of warm water native fishes. Smaller dams and diversions that are run off of the facilities on the Kern and Tule Rivers block the movement of warm and cold water species, and have encouraged conditions for bass or brown trout, both non-natives. Water temperatures downstream of dams are affected by volume of flow and temperature of the upstream reservoir. Warming temperatures can further limit distribution of native fishes. While minimum flows can mitigate for temperature, they cannot change the barrier to fish migration.

Culverts on road crossings can also disrupt habitat connectivity by restricting upstream movement by species. Culverts may represent a total barrier to fish upstream movements, or force amphibians and reptiles to attempt road crossings that may subject them to mortality. The percentage of the culverts that provide for upstream passage is not known at this time, but an assessment is underway.

Invasive Species: Fish, Amphibians, Snails

Many species of warm water non-native fishes have been introduced into lower elevations on the Kern, Tule and Kings Rivers associated with reservoirs. Non-native and hatchery trout were introduced into formerly fishless streams on the Tule, White and Deer watersheds and above natural barriers on the Kings and Kern Rivers. These trout were also introduced into areas where native trout were home to and caused the elimination of the native trout from much of their natural range. These non-native fish outcompete and feed on the native species in these lakes, including insects, frogs, and fish.

Non-native bullfrog has become widely dispersed across the forest at elevations less than 5,500 feet. The New Zealand mud snail has caused significant disruptions in stream food chains across many trout streams of the western United States. This invasive has not been identified on the forest yet.

Ecological Integrity

The dominant biodiversity characteristics of aquatic systems on the Sequoia National Forest indicate that stressors outside the natural range of variation have influenced fish and amphibians which cannot withstand and recover from most disturbances imposed by human influence, or are outside the natural range of variability. Connectivity, past land management, past introductions of non-native fish, disease, pollution and other stressors limit the biodiversity of forest aquatic systems. The timing of snow melt and thus peak flows is outside the natural range of variability on the forest. Climate change is a stressor which may limit water quality, timing, and quantity in the future. Invasive species, fire, and climate change remain stressors on watershed condition.

For more detailed information see the August 2, 2013 snapshot of the Sequoia National Forest Living Assessment Chapter 1.

Riparian Ecosystems

Natural Range of Variability: Vegetation and Fire and Fluvial Processes

Riparian meadow and non-meadow plant communities are formed by the interacting effects of flood frequency and intensity, soil saturation and depth of water table, proximity to the channel, the height above water level, sediment deposition, and ice scouring. Riparian non-meadow areas include both woody species of shrubs and trees, as well as herbaceous grasses, grass-like species, mosses, and ferns (Fites-Kaufman et al. 2007). These non-meadow riparian settings generally have shallower soils, or occur more often on steeper slopes, have rocks in the soils, and lower water-holding capacity of soils than meadows. Riparian vegetation along streams varies considerably on the forest, ranging from clearly defined bands of riparian forest dominated by white alder, willow, and Oregon ash, to simply a strip of herbaceous riparian plants with upland forest trees growing next to the stream throughout much of the conifer forest belt.

Fire suppression, and other management that limited fire in riparian zones, has had a direct effect on the composition and structure of riparian vegetation. Fires naturally spread into riparian areas, although sometimes in different ways and frequency than into adjacent uplands. Lack of fire creates less patchiness, less diversity of plants and structure, and fewer associated animals. Increased conifer and overall vegetation density and uniformity in riparian areas result in higher-intensity fires across large areas, sometimes across entire watersheds or basins. Information on the ecological role of fire in riparian areas, Native American fire management, and current observations to very high intensity fire at times suggests they are resilient to low and moderate intensity fire, and that ecological integrity is enhanced by low to moderate intensity fire. Over the next century, climate change is predicted to alter hydrologic regime, precipitation patterns and the role of fire in riparian areas. Restoration of flow regimes on regulated rivers, and restoring flowing water connectivity to the floodplains are important restoration goals for riparian ecosystems. Natural floods inundate healthy floodplains allowing for the growth of native seedlings. Equally beneficial are flows that remove riparian vegetation. In upper watersheds, there may be opportunities to restore floodplain connectivity, especially in meadows, consistent with the need for clean water and the ecological benefits.

Vegetation Structure and Integrity

The riparian non- meadow systems of the forest can be divided into two broad categories: scrub-shrub vegetation and forest-woodland. Scrub-shrub habitats are characterized by low, multi-stemmed woody vegetation in young or stunted stages of growth. These habitats support a diversity of shrubs. Riparian forest woodlands can be dominated by a variety of coniferous trees, such as pines, firs and incense cedar, and to a lesser extent, deciduous trees, such as black oaks, white alder, Oregon ash, and cottonwood. Having tall shading cover and a large source of organic matter in the form of leaves and needles provides excellent habitat for a diversity of plants and animals. These types of riparian areas provide a rich dense humid habitat for plants, amphibians, and small birds. Riparian vegetation and its structure are influenced across the landscape by topography, soils, stream channel activity, precipitation patterns, grazing, flooding, wind and fire. This highly variable spatial structure provides habitat and resources for a selection of understory plants, fungi, and invertebrates found in riparian areas across the forest. Annual fluctuations in flows and precipitation resulting from El Niño influences may have a significant influence on riparian tree establishment and understory diversity. Riparian vegetation is subjected to frequent wildfire disturbances.

Over the next century, climate change will alter hydrologic regime, precipitation patterns and the role of fire in riparian areas. Fire history in riparian areas appeared similar to that of the surrounding areas. However, post fire seedling recruitment and sprouting allowed riparian vegetation to be resilient. Riparian ecosystems are naturally resilient, provide connectivity among habitats, and create thermal refuge for fish and wildlife. Whether these valuable ecosystem services can adapt to changing conditions will be dependent on location. Common riparian species such as alder or willow can be sensitive to temperature. As these species migrate to higher elevations; more productive species from warmer areas could be planted to maintain these important wildlife habitats to increase resilience. Since the diverse community includes endangered and sensitive species, movement of these plants might be a viable option. An important key indicator is the presence and extent of non-native plants which indicate the extent of riparian degradation, or health and integrity.

Aspen, Willow and Alder

Aspen is a broad-leaved tree that occurs in diverse habitats on the forest, from wet areas to subalpine rock talus. It occurs most commonly around meadows and streams in the upper montane red fir and lodgepole pine forests. Although it currently occurs in less than one percent of the assessment area, it supports very diverse understory plant and bird communities. Several bird species of management interest are associated with aspen including northern goshawk, red-breasted sapsucker, warbling vireo, and mountain bluebird. Aspen distribution is greatly reduced compared to pre-European settlement, and many stands are in poor condition due to conifer encroachment and poor regeneration. Estimates suggest its extent in western North America has been reduced by as much as 96 percent, primarily because of fire suppression and historic overgrazing. Fire is also important in aspen stands because it kills young conifers that shade out light-loving aspen. California mule deer use aspen stands to feed in and the lush vegetation in aspen stands cover for fawning. Grazing by domestic livestock, sheep and cattle increased dramatically in the mid-1800s and had a dramatic effect on aspen and meadows in general. Aspen sprouts, or regeneration, are favored browse. Fencing can result in higher aspen sprouts. In the intermountain west, decreased aspen growth has already been attributed to higher temperatures and extended drought. Annual fluctuations in available soil moisture resulting from El Niño influences on snow pack depth may have a significant influence on establishment of plants. Higher temperatures and earlier snowmelt appear as a trend outside the natural range of variability.

In riparian areas, sites are dominated by shrubs, herbs and grasses. Complex early seral forests are where there are residual legacies from previous older forests, such as large snags and logs. In the past, fire, drought, and wind combined to create openings in the canopy, creating patches of early seral habitat across the landscape. In riparian areas, willows and alders can colonize these openings. Snags and shrubs are the most common nesting or resting habitat used by birds, reptiles and amphibians. However, fire suppression has altered these processes of habitat creation and succession beyond the natural range of variability. Without fuels management in riparian areas and a return of controlled fire to the landscape, the patchy nature of a natural landscape will be less likely to withstand and recover from most disturbances imposed by human influence or that are outside the natural range of variability.

Meadows and Fens

Meadows encompass about 10,000 acres or ten percent of the total acres of the Sequoia National Forest. These meadows are not evenly distributed across the forest. For more information, see Chapter 2 of this assessment. Fens are continually wet areas where soils rich in organic material (peat) are at least 16 inches deep. Fens make up about 10 percent of the meadow acreage. Many fens are inhabited by Sphagnum moss, which was formerly thought to be rare in the High Sierra. Fens are important in modeling when considering CO_2-induced global change because they are a major sink for atmospheric carbon. Another 1,000 acres on the forest has less well developed rich organic soils but are moist late into the season, except possibly in drought years. Meadows, seeps and springs in the drier southern Sierra Nevada Mountains provide important habitat diversity and habitat for plants and animals. Sundews, a carnivorous plant, are only found in fens. Meadows, seeps and fens are dependent on snowpack to sustain the water throughout the long dry period of summer. There is little information about the current trends for springs. As the rain-snow interface changes, lower elevation meadows and fens will be increasingly at risk. Restoration of these systems holds great potential to provide multiple ecological and social benefits, despite their small share of the landscape (Long et al. 2013). The integrity of fen ecosystems is tied to the hydrologic conditions that support rich organic soil (peat) accumulation. There are a number of land uses and use features that can affect the maintenance of these special areas such as water diversions, improper livestock grazing, ditches and roads (Weixelman and Cooper 2009).

Understory Plant Diversity

One of the most important ecological effects of fire is to promote sprouting of hardwood shrubs, trees, herbaceous flowering plants, and grasses that otherwise have a difficult time competing with densely canopied conifers that shade them out. However, fuel or vegetation management has been constrained in riparian corridors due to concern for water quality and sensitive riparian ecosystems. Riparian zones are among those areas most impacted by non-native invasive species. An important characteristic is the presence and extent of non-native plants which indicate the extent of riparian degradation, or health and integrity.

Animal Diversity

Riparian communities contain more plant and animal species than any other California community type, and about one fifth of terrestrial vertebrate species in the Sierra Nevada depend on riparian habitat. About one quarter of wildlife species that depend on riparian habitat are considered at risk of extinction today. Connectivity of habitats is important for migratory birds, as well as amphibians and reptiles that use riparian areas. Species such as the willow flycatcher, Mountain Yellow Legged frog, and Great Gray Owl depend on different aspects of riparian habitats and openings in meadows.

Obligate riparian bird species show strong declines in population since 1868. As of the mid-1990s, half of the 32 amphibian species, and almost half of the 40 fish species or sub-species found in the Sierra Nevada were endangered, threatened, or of special concern. Additionally, 85 percent of Sierra Nevada watersheds are characterized as poor to fair for aquatic biotic communities, including amphibians and fish. The decline in native species is outside the natural range of variability for these species.

Connectivity

While 93 percent of studied watersheds in the Sierra Nevada have clear gaps in the riparian corridor, especially in lower elevation areas, many of the riparian corridors are in steep canyons and forested slopes on the Sequoia National Forest. Since riparian areas on the Kern River Canyon have burned at regular intervals in recent years, these riparian areas provide a variety of habitats for dependent wildlife. Roads, road crossings, timber harvest, private lot clearing, livestock grazing, and dam and diversion dewatering can all block connectivity of habitat for dispersal of seeds and wildlife.

Ecological Integrity

The dominant biodiversity characteristics of riparian ecosystems on the Sequoia National Forest indicate that stressors outside the natural range of variation have influenced birds and amphibians which cannot withstand and recover from most disturbances imposed by human influence, or are outside the natural range of variability. Lack of connectivity, past land management, disease, pollution and other stressors limit the biodiversity of riparian ecosystems. However, climate change is a stressor which may limit plant species in the future as temperature, water availability, timing and quantity of water change. It is not known how riparian areas will function in the future as warming trends continue. When vegetation structure alone is considered, riparian areas in non-meadows are currently overall in good condition, and most are able to recover from most disturbance imposed by human influence or are within the natural range of variability. However, invasive species, fire, and climate change remain stressors on riparian condition. For more detailed information see the August 2, 2013 snapshot of the Sequoia National Forest Living Assessment Chapter 1.

Contributions the Plan Area Makes to Ecological, Social or Economic Sustainability

In 2004, the Forest Service produced the National Report on Sustainable Forests (USFS 2004). It included a summary of the current condition of forests, based on a variety of ecological, social and economic indicators of sustainability. Much of the information came from Forest Inventory and Analysis (FIA) plots, satellite-based vegetation maps, and national economic and social monitoring of national forests.

Summary from National Report on Sustainable Forests 2004

Characteristic	Condition Bio-Regional Assessment (2013)	Condition Forest Assessment (2013)	Trend
Ecosystem Diversity			
Extent of area by forest type and successional stage or age-class	Low levels of old forest and possibly early seral. Low levels of within-patch diversity.	Moderate levels of old forest, possibly low levels of early seral. Low levels of within-patch diversity.	Trend to maintain except with warming climate, high possibility of increased high intensity fire that could decrease old forest and increased early seral habitat. Unknown effects on within-patch diversity- could increase with managed fire and restoration.
Extent of area in protected areas	High in southern half of bioregion at high elevations.	Low at low and mid-elevations, high at higher elevations (wilderness).	Stay the same.
Fragmentation of Forest Types	Low for most possible fragmentation of early seral, especially complex early seral.	Low for most, high fragmentation of early seral, especially complex early seral.	Increase fragmentation for old forest and decrease for early seral with expected changes in climate and fire.
Species Diversity			
Number of forest-dependent species	See Chapter 5		
Status of species at risk (legal status*)			
Genetic Diversity			
Species with range contraction	Fisher contracted. Some locations of owls affected by concentrations of recent high intensity fires All native fish and amphibian species	Unknown.	Unknown. Aquatic species populations are declining for a variety of reasons; climate change will further stress these species.
Invasive Species	Unknown.	Unknown.	

Extensive fire restoration in the Kern Plateau has contributed to increased resiliency of ecosystems in this landscape. This is unique for the bio-region and much of the western United States. Outside of this area overall, continuous vegetation cover is present but within-patch diversity is greatly reduced from estimated historic conditions. This is largely due to fire suppression and past forest management, which has resulted in high forest and vegetation densities, and very high surface fuel loads. These conditions, combined with warming and drying climate trends, are leading to high vulnerability to uncharacteristically, large, uniformly high intensity fires. This could result in fragmentation of old forest habitat currently used by species of concern including the California spotted owl, fisher, and marten. It will have unknown effects on the extent and quality of early seral vegetation.

The diversity of unusual plant assemblages exceeds that of any other national forest in the bio-region and perhaps in California. This is because of its proximity to the west side of the Sierra, High Sierra, Mohave Desert, southern California, the California Valley and the Great Basin. The geography provides some additional resilience to climate change because of the natural migration route for northward migrating species across a wide range of elevations.

Historically, riparian and aquatic ecosystems were valued for their economic uses, including transportation corridors, water supply, electricity, construction materials, waste disposal, settlement, agriculture and livestock. Riparian areas are extremely important sources of shade, food, and refuge during high flow events for aquatic organisms. Biologically, both aquatic and riparian areas provide special habitat for some endangered or threatened species, refuge and water for upland species, corridors for species movements, and thermal refuge for aquatic species.

Information Gaps

Ecological integrity is difficult to characterize, as described above. Additional characteristics may be developed in the future. Limited or missing information or gaps in our knowledge are described below.

Terrestrial

Some aspects of ecological integrity have much information, such as the location of fisher, marten and California spotted owl. However, many aspects of their habitat and use of that habitat are unknown. Of key importance on the Sequoia National Forest are the habitat relationships of the fisher occurring in the more open forests on the Kern Plateau. In particular, the spatial distribution of large trees and snags are unknown. The location and amounts of complex early seral forest are unknown. It is unknown how fisher, marten, California spotted owl and goshawk respond to restoration treatments or high severity fire. It is unknown how other animals are distributed or affected by restoration treatments or vegetation diversity such as black-backed woodpecker, songbirds or small mammals that carnivores and raptors depend on. Moreover, the condition and trend of many high elevation species sensitive to climate change is unknown, such as white bark pine and alpine chipmunk.

Aquatic and Riparian

In the face of climate change, restoration of aquatic ecosystems in order to promote resilience of aquatic ecosystems is important; however, it is not known which systems are at the highest risk or are the highest priorities. Aquatic invertebrates have not been sampled in springs, seeps, or other special aquatic habitats across the forest in the last 20 years. Predictions under climate change are that water and air temperatures will warm and precipitation patterns will change. Cold water trout are influenced by warming temperatures and timing of scouring flows. It is not known how quickly this change will occur, or what the potential effects on frogs, invertebrates, plants, lichens, and wildlife are. The key plant and wildlife characteristics to evaluate wetlands and streams are not known. The tradeoffs between landscape scale consideration of managing riparian areas for fire and fuels management methods in riparian areas are not understood. There is some data on habitat characteristics for native warm-water species, but it is unknown how these species respond to flows on regulated rivers.

Chapter 2: Assessing Air, Water, and Soil Conditions

This assessment focuses on the current condition of air, water and soil resources across the Sequoia National Forest. Human and ecosystem health are directly impacted by pollutants in the layer of the atmosphere closest to the earth's surface .Water quality is directly influenced by erosion of soils, pollutants, dams, roads, and management activities associated with the forest. Soils are influenced by erosion, pollution, and land disturbing activities. All lands in the Sequoia National Forest were included in this assessment. In some sections, broader patterns for the larger bio-region were also discussed.

Important Information Evaluated in this Phase

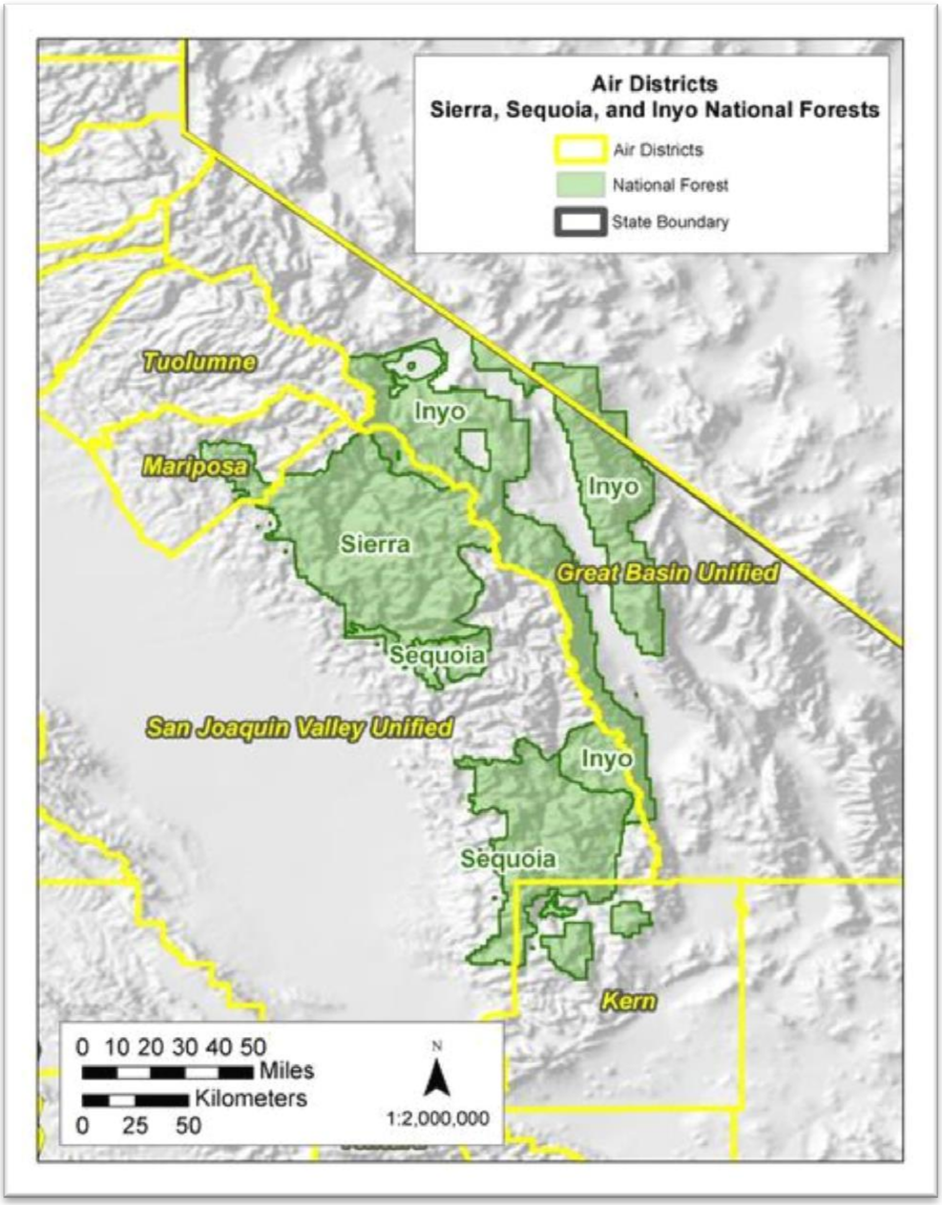
Information came from Chapters 2 and 8 of the draft Bio-Regional Assessment, the Sequoia National Forest Living Assessment Chapters 1, 2 and 8, and the draft Science Synthesis compiled by the Forest Service, Pacific Southwest Research Station (Bytnerowicz et al. 2013, Collins and Skinner 2013, Hunsaker et al. 2013, and Moghaddas et al. 2013). In addition, additional information was assembled to address natural range of variation for water resources.

Key Air Conditions

Airsheds

The Sequoia National Forest intersects two air basins and air pollution control districts (APCD): the San Joaquin Valley Unified APCD and the Eastern Kern APCD.

The map below shows the location and boundaries of air districts on the Sierra, Sequoia, and Inyo National Forests. The primary dividing line runs along the crest of the Sierra Range, between the Great Basin Unified to the east of the crest, and the San Joaquin Valley to the west. Ninety percent of the Sequoia National Forest falls in the San Joaquin Valley Unified Air District. The southeastern part of the forest fall in the northwest corner of the Kern Air District.



Air Districts on the Sierra, Sequoia and Inyo National Forests

Location and Extent of Sensitive Air Quality Areas

Lands under extra protection are called Class I and apply to wilderness or national parks which were larger than 5,000 acres and were in existence in 1977. Only the Domelands Wilderness is Class I on the Sequoia National Forest. The Sequoia National Forest has lands federally designated as in non-attainment for $PM_{2.5}$ and ozone. California standards are stricter than federal standards, resulting in non-attainment for ozone, $PM_{2.5}$, and PM_{10}.

For more detailed information see the August 2, 2013 snapshot of the Sequoia National Forest Living Assessment Chapter 2, lines 4-58.

Relevant Emission Inventories, Trends, Conditions

Emissions types and amount vary between air districts and are reported as yearly emissions inventories by air basins The pollutants covered by this inventory are: total organic gases, reactive organic gases, carbon monoxide, nitrogen oxides, sulfur oxides, particulate matter (PM), particulate matter less than 10 micrometers (PM_{10}), and particulate matter less than 2.5 micrometers ($PM_{2.5}$). The most current inventory is for 2010.

Total emissions by pollutant type for the Great Basin Valleys and San Joaquin Valley Air Basins 2010

Total emissions by pollutant type (tons per day)	Great Basin Valleys Air Basin	San Joaquin Valley Air Basin
Total organic gases	57	1635
Reactive organic gases	46	361
Carbon monoxide	52	1272
Nitrogen oxides	8	524
Sulfur oxides	1	23.7
Particulate matter	136	539
Particulate matter (PM2.5)	12	104
Particulate matter (PM10)	82	302

There is a general north to south trend of pollution with the Sierra Nevada bio-region**.** Air quality in the north is generally good and declines toward the south. The Central Valley of California and the surrounding mountain ranges act as a ‘bowl’ trapping pollution in that valley. The Sierra Nevada bio-region is the eastern boundary of this Central Valley bowl.

For more detailed information see the August 2, 2013 snapshot of the Sequoia National Forest Living Assessment Chapter 2, lines 4-100.

Secondary Pollution - Ozone

Ozone is a secondary pollutant, which means it is not directly emitted to the atmosphere. It is formed through chemical processes induced by sunlight exposure in the presence of other pollutants. Ozone injury of vegetation was established in the late 1970s to late 1980s throughout the Sierra Nevada (Bytnerowicz et al. 2013). No critical loads for ozone have been established. An index of ozone exposure was created to better understand how ozone impacts vegetation communities. All of the Sequoia National Forest is modeled as high vegetation exposure to ozone.

Smoke Emissions

Smoke from fires affects the air quality in in the Sierra Nevada Range. These impacts are short term, meaning that smoke from fires can be severe but impacts are limited to when fires are actually burning. Smoke often impacts more than a single basin as it can move long distances from its source. Local air districts have established regulations to minimize the impacts of smoke from prescribed fires.

Critical Loads

Critical loads are defined as a concentration of air pollution or total deposition of pollutants above which specific negative effects may occur. While it is well documented that ozone causes damage to conifers in the Sierra Nevada, ozone critical loads have not been established (Bytnerowicz et al. 2013). The Sequoia National Forest exceeds airborne nitrogen deposition critical loads. Airborne nitrogen could have effects on nitrogen cycling, water quality, tree health, biodiversity, and sensitive indicator species, including lichens (Bytnerowicz et al. 2013).

The Forest Service monitors Class I wildernesses through paired photographs. The Domelands Wilderness has an overall decreasing trend in air pollution because visibility is increasing. However, levels still exceed regulatory and healthy ecosystem limits in many locations.

Below are two pictures taken in the Domelands Wilderness. In the picture on the left, the mountains across the left and center of the photo are clear, and visibility is 186-236 miles. The photo on the right was taken on a low visibility day (less than 11 miles) from the same location. In this photo, the mountain range is not visible and the entire picture looks like it has a gray film on it.

Comparison of Domelands under poor and good visibility

For more detailed information on air quality conditions see the August 7, 2013 snapshot of the Sequoia National Forest Living Assessment Chapter 2, lines 100-216.

Key Soil Conditions

Geology and Geomorphology and Other Factors Important to Ecological Integrity and Soil Quality

The Sequoia National Forest has a great variety of soil types (Sequoia Soil Survey 1996). Primarily, these soils differ in their parent material, climate, topography, vegetation, and degree of development. Most soils are derived from solid bedrock, primarily igneous granite with smaller areas of metamorphic roof pendants. There are also soils derived from glacial till and meadow sediments. Topography varies widely, with the lower elevations (1,000 to 7,000 feet) having steep slopes and being more highly dissected into drainages and ridgelines. The higher elevations tend to have more subdued topography with gentle basins and moderate slopes. Warmer temperatures, sufficient precipitation, and gentle topography create great conditions for soil development at the middle elevations (5,000 to 7,500 feet). Soils are less well developed at higher (more than 7,500 feet) because of lower temperatures and a shorter growing season. At lower elevations (less than 5,000 feet), a lack of precipitation and a pronounced summer drought limit soil development.

These differences result in a broad range of soil productivity across the Sequoia National Forest. The most productive soils are found at middle elevations on the western side of the forest up to about 6,500 feet in elevation. Mixed conifer vegetation, including ponderosa pine, west side mixed conifer, and the giant sequoia groves on the forest are located throughout these soils. This section of the forest has seen the most logging and resultant soil disturbance. Soils at higher elevations (7,000 to 12,000 feet) in the colder soil temperature regime tend to be shallower, less well developed and coarser textured.

Soils are generally drier in the western portions of the forest or where they are shallow due to steep slopes. High runoff is common, and occurs because the infiltration rate of the soils is often exceeded by rainfall intensity. This has the potential to affect rainfall runoff amounts and timing. Soils found in these lower foothills are typically moderately deep, gently rolling to very steep, and well drained (Hanes et al. 1996). The soils range from rock outcrops to coarse sandy loam to clay. The soils in the drainages consist of medium and fine-textured soils developed in alluvium weathered from igneous and metamorphic rocks. The soil chemistry varies in acidity from neutral to medium acid, with infiltration rates that vary from slow to moderate (Hanes et al. 1996).

At the middle elevations, especially in flatter terrain along the meadow areas and basins soil infiltration and depth is moderate to good due to generally moderate to deep soils on granite bedrock. Where soils are deeper the water holding capacity of the soil is generally good. Soils are shallowest in the ridges from 7,000 feet and above and deepen as one descends into the foothills on the west side of the forest. Soil infiltration and depth is poor to moderate at the higher elevations around areas of exposed bedrock monoliths and outcrops.

Soils in the northern portion of the forest are predominantly comprised of coarse sandy loam and sandy clay loam derived from granitic rock of the Chawanakee-Chaix and Dome-Chaix series (Hanes et al. 1996). In the areas of caves and marble roof pendants the soil is derived from metamorphic rock in the Hotaw-Brownlee-Rock Outcrop series. The higher acidity soils are found in the region of caves in the northern block of the forest. This is from the formation of carbonic acid as ground water flows through marble roof pendants. Rainwater and snowmelt disappear into fissures and later flow into underground rivers, eventually flowing into the Kings River downstream of the marble bearing formations.

Soils in the southern portion of the forest, generally in the Tule River and Kern River Watersheds, are predominantly comprised of coarse sandy loam and sandy clay loam of the Glean Variant, Bald Mountain, Chaix, Chawanakee, Holland, Woolstaff, Wind River, and Hotaw series (Hanes et al. 1996). These soils were formed in place from parent granitic bedrock and limited areas of metamorphic rock.

Current Inventories of Soil Conditions and Improvement Needs

Maintaining soil in place is paramount to current and future soil quality, resilience, and health. Recovery of severe erosion is beyond human timescales (Moghaddas et al. 2013). Forest management activities or fire can increase erosion of soils (Moghaddas et al. 2013). It is unknown how sedimentation rates on the Sequoia National Forest have changed with changes in active timber management between the early 1900s and the present.

Planned fuel reduction or timber projects result in lower long term erosion rates than experienced following wildfires (Moghaddas et al. 2013). Wildfires are inevitable if fuel loads are not reduced (Collins and Skinner 2013). While soil loss on a skid trail is greater than in the areas between skid trails, the loss following a wildfire is much greater than in an undisturbed forest (Moghaddas et al. 2013).

Forest roads are one of the major sources of sediment on national forests in California, including the Sequoia National Forest. Road decommissioning is the most effective approach to reducing road-related sediment delivery. However, for roads necessary for forest management and recreation, road maintenance including storm proofing, is the primary means of controlling erosion. Declining budgets have reduced the ability of the national forests in California to maintain and stormproof roads.

Roads are likely to be substantial sources of sediment in some actively-managed forested watersheds with overall low sediment yields. Road related sediment does not account for a majority of sediment from high-yield watersheds. Other sources of erosion and sediment need to be considered in planning effective activities to control sedimentation. Other sources are natural background erosion, wildfires, vegetation management, roads and livestock grazing.

For more information on soil resource conditions see the August 7, 2013 snapshot of the Sequoia National Forest Living Assessment Chapter 2, lines 217-282.

Key Water Conditions

Watershed Conditions and Impaired or Contaminated Waters

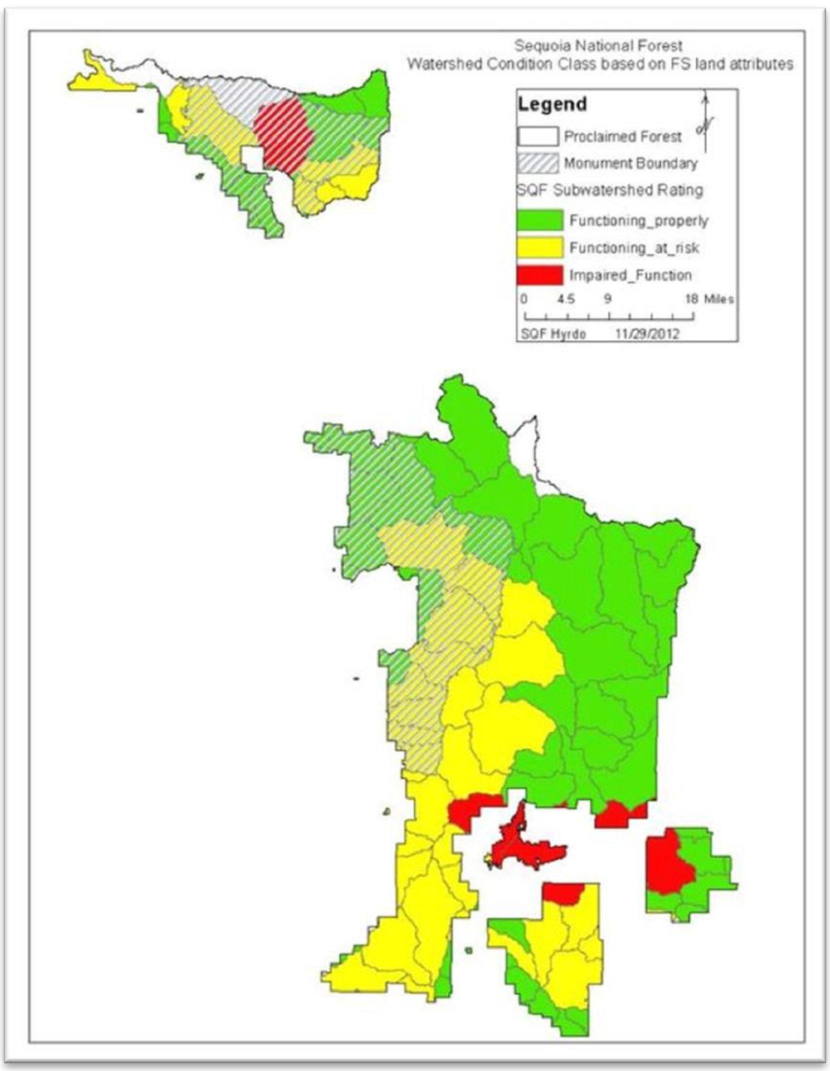
Surface water resources are predominately associated with the Kings, Tule and Kern Rivers. There are additional perennial drainages that flow from the west side of the forest that include Poso, White River and Deer Creeks, and to the south include drainages associated with Walker Basin, Little Dixie Wash and Cottonwood Creek.

Six hydroelectric projects are located on the forest, four on the Kern River, and two on the Tule River. These hydroelectric projects are run off of the rivers, but do influence the flows and timing of flows of the rivers. Outside the forest, there are several reservoirs including Pine Flat Reservoir, Lake Isabella, and

Success Lake that eliminate connectivity of habitat for native warm water species, and have introduced non-natives into the river systems.

Properly functioning watershed conditions create and sustain functional terrestrial, riparian, aquatic, and wetland habitats capable of supporting diverse populations of species. On the Sequoia National Forest, 43 percent of watersheds were properly functioning, 52 percent were "functioning at risk", and five percent had" impaired" function. Habitat fragmentation, flow alteration, exotic species, road density, and road proximity to water were the most common stressors affecting watersheds that were not properly functioning.

The map below shows properly functioning watersheds at higher elevations, in roadless areas, and away from dams. The watersheds in fair or poor condition are associated with dams in both south and the north.



Sequoia National Forest watershed condition indicator results

Water Quantity, Quality, and Timing, and Distribution of Water Resources

Surface water resources for the Sequoia National Forest are predominately in the Kern and Tule Rivers. See the table below. Precipitation is variable from year to year and tied to large scale and long term climatic cycles, the Pacific Decadal Oscillation and the El Nino Southern Oscillation. The three rivers that produce the most water from the Sequoia National Forest, the Kern, the Tule and the White River produce approximately 835,000 acre feet of water per year on average (Null et al. 2012). Flows from Sequoia National Forest streams have been highly variable over the span of several decades. A part of the natural variability in flow is due to the long and short term climate cycles that influence precipitation. Timing of peak flows from snow melt is earlier than it was ten years ago, and reflects warmer than normal spring temperatures (Stewart 2009, Hunsaker et al. 2013).

Groundwater sustains flows into the long dry season but is dependent on snow to recharge (Fount 2009). Since snowmelt occurs earlier and the elevation of snow may increase, where and when groundwater recharge occurs would change. Springs and wet meadows are considered groundwater dependent systems to maintain their flow rates and ecosystem function. Approximately 556 meadows are scattered throughout the forest, except in the Kings Canyon inner gorge and between the Tule Reservation, north to the boundary of Sequoia National Park. Lower elevation meadows would be influenced by warming and the effects on groundwater recharge (Viers et al. 2013).

The following table describes physical characteristics of the two major watersheds of the Sequoia National Forest from north to south. This table was adapted from Null et al. 2012.

Physical characteristics of the two major watersheds of the Sequoia National Forest

River	Area (km2)	Mean annual flow in millions of cubic meters per year	Average rain and snowfall (precipitation) in millimeters per year	Range of precipitation, minimum and maximum values, in millimeters per year	Elevational range of the watershed in meters
Tule	1,015	199	764	286–1,192	174–3,119
Kern	5,983	926	560	244–1,473	171–4,418

Water quality 303(d) impairment was found at Hume Lake, Deer Creek and Lake Isabella. Acidity (pH) and low dissolved oxygen were responsible for impairment. Hume Lake and Lake Isabella are human-made lakes in an area with few natural lakes. Water temperatures in larger streams may be influenced by limited riparian shading, especially below dams or where pulse flows for hydropower generation occur.

Alteration of flow paths from roads can affect meadow and wetland function, with the effects extending far beyond the area road itself (Hunsaker et al. 2013). A local study in the Kings River Experimental Watershed found that only 13 percent of the road length in the study area allowed streams that they crossed to be ecologically-connected on either side of the road. The Sequoia National Forest is developing a prioritized list of sites where roads block stream connectivity, and are applying well developed principles for upgrading or decommissioning roads (Hunsaker et al. 2013).

For more detailed information on water conditions see the August 7, 2013 snapshot of the Sequoia National Forest Living Assessment Chapter 2, lines 283-499.

Historic Context under which Hydrologic Systems Developed

Major floods in the Sierra Nevada occurred in 1861-62, 1906, 1909, 1955, 1964, 1986, 1997, and 2005 (Das et al. 2011). Based on these dates, the frequency of large floods may be increasing. Larger dams such as that creating Lake Isabella were built originally for flood control. Across the Central Valley, warming springs have resulted in earlier snow melt and delivery of peak flows to reservoirs (Cayan et al. 2001, Faunt 2009). Combined with the concerns over earthquakes, the need to keep the reservoir levels lower for safety, and the changing hydrograph, management of water will be a challenge. Temperature models suggest an increasing trend in temperature, with increases of about 2.7° to 8.1°F. While these models suggest that most precipitation will continue to occur in winter, snow melt will likely be earlier (Cayan et al. 2008).

Under the current climatic regime, stream flow from the forest is governed by melting of snowpack (Faunt 2009). Between 1875 and 2005, seven predominantly wet periods and six predominantly dry periods were identified for the Central Valley. The departure from expected precipitation is a measure of precipitation relative to a long term average (Faunt2009). The cumulative departures from average suggest that the Central Valley was subject to a precipitation deficit since the 1930s (Faunt 2009). During the second half of the 20th century, California experienced multi-year droughts during 1959–61, 1976–77, and 1987–92 (California Department of Water Resources 1998). Recent studies indicate that the relative amounts and timing of precipitation and inflow from drainages entering the Central Valley are changing (see review in Faunt 2009).

Nature, Extent and Role of Existing Conditions and Future Trends

Competition for water uses occurs on the Sequoia National Forest. Water for hydroelectric, flood control, irrigation or drinking water alters the flow timing and amount throughout the year. Native fish species both warm water and cold water are influenced by the changing flow conditions. Recreational rafters want high flows in the spring and early summer. These conflicts mean that there isn't enough water for all user groups. Climate change is expected to reduce the supply, and may increase the competition for water use. Development and population growth will put even more demand on the available water. California counties within the bio-region are expected to increase in population by 69 percent, with the highest growth in Fresno, Kern, and Tulare Counties.

Climate predictions for the Central Valley and the southern Sierra Nevada include increased warming, less snowpack, and earlier spring snowmelt (Cayan et al. 2008, Faunt 2009). These changes would influence the amount of water supply that can originate from forest lands and from precipitation. Uncertainty about the water supply makes planning for distribution of water in the future challenging.

Consumptive Uses

The growing urban footprint, increasing environmental water demands and population increases have resulted in higher demand for water for municipal and industrial purposes. Most of the runoff from the northern Sequoia National Forest is carried by the Kings River to Pine Flat Lake and Dam. At the southern end of the forest, the Kern River flows into Lake Isabella and then down into the southern end of the Central Valley. Three reservoirs on or adjacent to the Sequoia National Forest have a historic average of approximately 1,360 thousand acre feet of water. Lowest values were in 1977, the driest year on record and highest in 2011, a very wet year. Tulare Lake reservoir storage is 60 percent lower when compared to the historic average, but is still well within the variation among years. Overall, the reservoir average storage since 2008 is similar to the historic average (CDEC 2013).

Non-Consumptive Uses

Six operationally active hydroelectric plants on the Sequoia National Forest do not store river water. Water plays a major role in providing a diverse set of recreation opportunities including rafting, camping and fishing. The Sierra Nevada ecosystem is the setting for a large recreation and tourism industry. The Kern River, the Little Kern and the South Fork Kern has potential for habitat for Kern River Rainbow, Little Kern Golden Trout, and Golden Trout, Mountain and Foothill yellow-legged frog, and the Western pond turtle. Other rivers and streams draining the forest have habitat for western pond turtle, and native warm water fish species.

Nature and Distribution of Federal and Non-Federal Water Rights

The Sequoia National Forest has 550 water right filings. These water rights include but are not limited to recreation, fire protection, road maintenance, wildlife, domestic, stock watering and power production. Tribes throughout California have rights to access adequate supplies of water for direct consumption, agricultural purposes, or protecting existing resources. Tribes may have senior water rights and some water sources may be defined as sacred sites.

Effects of Land Use, Projects, Activities, and Other Stressors on Hydrologic and Geomorphic Processes and Water Resources

Dams and hydroelectric projects disrupt the connectivity of streams and rivers, preventing fish from migrating up or down river to stay within temperature tolerances. High flows needed to scour sediments and provide fish access to floodplains for feeding are suppressed below reservoirs. Climate predictions indicate that changes in flow patterns will stress meadows, streams and rivers in several ways. Peak flows are earlier and more intense, possibly increasing erosion and leaving less water later in the summer (Hunsaker et al. 2013). Increased erosion will mean more soil loss from meadows at a rate higher than background. These possible changes will have consequences for the people, plants and wildlife that depend on these systems. Restoration of meadows and their streams will be important in the coming years to maintain hydrologic functioning at mid to high elevation meadows (Long et al. 2013).

Ecological, Social, and Economic Roles Water Resources Play on the Broader Landscape

The mountains, lakes, streams and meadows of the Sierra Nevada are valued for their beauty. Streams and rivers are used for water supply, irrigation, transportation, hydropower, waste disposal, mining, flood control, timber harvest, and recreation. Many of these uses have made aquatic and riparian systems the most altered and impaired habitats of the Sierra Nevada. As the population of California has grown, so has the demand for water, leading to greater diversion and de-watering within Sierra Nevada aquatic systems. The synergistic impacts of the declining water table depth due to less groundwater recharge, coupled with more climate variability will likely mean further degradation of watersheds, and will threaten ecological sustainability.

Hydropower production on the forest is approximately 639.395 megawatts. One megawatt is enough electricity to supply 1,000 homes. The south San Joaquin Valley agricultural production value is worth over $17 billion and is dependent on water from groundwater, the Friant-Kern Canal and local water supplies. Groundwater is recharged in the Sierra Nevada, the San Joaquin River provides the water for the Friant–Kern Canal, and much of the water from the southern Sierra Nevada goes into local water supplies. The Sierra Nevada ecosystem produces approximately $2.2 billion in commodities and services annually and water accounts for more than 60 percent of that total value (Hunsaker et al. 2013). Predicted population increases in the state can result in more people benefiting from these water and power commodities and services. Conflicting uses for water can result in rising costs for this resource. The trend in this value is increasing and will continue to increase in the future.

For more detailed information on water conditions see the August 7, 2013 snapshot of the Sequoia National Forest Living Assessment Chapter 2, lines 495-541.

Contributions the Plan Area Makes to Ecological, Social or Economic Sustainability

There are two different ways that sustainability of air, water, and soil were addressed. The first was a general comparison of current conditions relative to the natural range of variability. Information is very limited on the natural range of variability of air, water, and soil. Second, a first approximation of conditions of key sustainability characteristics from the National Report on Sustainable Forests (2004) was made. Air, soil and water conditions have all changed considerably since European settlement.

Human and ecosystem health are affected by pollutants from the Central Valley and the San Francisco Bay Area (Bytnerowicz et al. 2013). On the other hand, smoke from fires is far less prevalent than it was thought to be historically. Smoke would have affected haze and visibility, but would not have had negative impacts on vegetation. It could have impacted Native Americans living in the vicinity when it was more severe. It is likely that severe levels were less common since fires were more frequent and less intense overall.

Soil has been modified in some areas and in others is largely intact. In the lower and mid-elevations, mining, logging, and associated roads have altered soil structure and organic matter. At higher elevations, little or no change in soils has occurred. Overall current soil conditions are fair to good, but are at risk because of dense vegetation and fuels that support high intensity fires, resulting in a very high potential for soil erosion.

In the early twentieth century, dams were developed for irrigation, hydropower generation and drinking water on each of the major rivers and on some of the tributaries. These dams support the most productive agricultural counties in California. Clean water for drinking, irrigation, and hydropower generation is highly valued among communities and farmers of the southern San Joaquin Valley. However, unforeseen changes in groundwater recharge, timing of flows, and warming temperatures lead to uncertainty. Sustainability of high quality water is at risk from increased erosion as a result of more flooding associated with predicted climate changes. Quantity and timing of water is vulnerable to changes in climate. Snowmelt is occurring earlier than it did 20 years ago.

This table represents characteristics of sustainability from the National Report on Sustainable Forests (2004). Much of the information used to estimate the conditions will come from the National Inventory and Analysis (FIA) program. This is a nation-wide network of systematically placed inventory plots. Information on these characteristics is not available at this time.

Characteristics of sustainability from the National Report on Sustainable Forests 2004

Characteristic	Condition	Trend
Area subjected to levels of air pollutants that may cause negative impacts to ecosystems	Majority of air basin affected	Levels of some pollutants have decreased slightly but major changes not expected.
Area of forest land with significant soil erosion	Small, site specific areas.	Could increase dramatically with single high intensity fire
Percent of stream length in which stream flow and timing have deviated significantly from historic range of variation.	Larger rivers deviate significantly from historic range of variability in stream flow, connectivity and timing of flows. Snow melt is two weeks earlier in the last 10 years.	Connectivity is not expected to improve over next 10 years; timing of peak flows is predicted to occur earlier every year. Snow melt will continue to occur earlier.
Area and percent of forest land with significant compaction.	Small, site specific areas.	Not expected to change, except increased recreation use could increase.
Area of forest with significantly diminished soil organic matter and/or changes in soil chemical properties.	fUnknown.	Could increase dramatically with single high intensity fire, over long term continuous loading of Nitrogen from the air could influence soil productivity and chemical properties.
Percent of water bodies with significant variance of biological diversity from NRV.	Many frogs and toads have been lost from lower elevations. Many native fish are blocked from movement up large rivers. Birds dependent on meadows have been in decline. Nonnative fishes in reservoirs move into native warm water species habitats and have potential to outcompete the natives.	Active management to improve conditions would be required to preserve biodiversity.
Percent of water bodies with significant variation from historic levels of chemistry and temperature.	Several rivers and their reservoirs off forest are impaired for temperature.	In conjunction with predicted warming and lower flows this is not likely to improve over next 10 years.
Area and percent of forest land with an accumulation of persistent toxic substances.	Significant levels of nitrogen are deposited into the forested lands and water. To date lichens are showing effects but soils do not appear to be effected yet.	Unknown response time.

Information Gaps

Air

Although ozone exceeds regulated levels and some ecosystem damage has been observed, ecosystem critical loads have not been developed (Bytnerowicz et al. 2013). There is also a need for improved tools and models on air quality associated with prescribed fire and wildfire during different conditions (Bytnerowicz et al. 2013). This would improve planning and evaluation of treatments to reduce uncontrolled wildfires. At this time, only broad and general assessments can be conducted.

Soil

Comprehensive surveys of soil condition are lacking. Information is site specific to management activities. Information from the National Inventory and Analysis (FIA) plots on the Sequoia National Forest is not readily available but would be highly useful for evaluating sustainability. Mastication of wood during thinning can produce deep residues, and how this could impact rates of nutrient cycling, nitrogen availability, or soil aeration is not known. Fire treatments in masticated stands may result in more severe effects to soils. No long term studies exist to address these issues.

Water

There are gaps in information regarding:

- effects of long term nitrogen deposition on nutrient cycling in streams
- effects of fire on water quality at low and moderate levels of fire
- cumulative landscape level effects of fire on water quality and quantity
- uncertainty of climate change
- uncertainty about ground water recharge in the face of changing timing of snow melt
- uncertainty about landscape level and long term effects of roads, salvage harvesting, fuels reduction and cattle and other livestock on water quality, sustainability and improvement of biodiversity of meadows and streams, riparian vegetation structure (for meadow birds and amphibians), thermal cooling of streams (for fish, amphibians, and macro-invertebrates), and lateral floodplain inundation

Chapter 3: Assessing System Drivers and Stressors

Drivers and stressors are recurring events, processes or actions that affect ecosystems. These effects are important to ecosystem condition. For example, fire used to and can play an important role by reducing understory plant biomass and thinning understory trees. It used to and can create variation in habitat which is important for biodiversity. In these ways, it is a “driver” of ecosystem condition. Fire is a stressor when it is large, uniform, of high severity and outside the natural range of variation. The context in which fire occurs is also important. For example, because old forest habitat is limited and some associated species like the fisher are of concern, extensive high severity fire in these areas has great impact on these sensitive resources.

Other important drivers and stressors are insects and pathogens, invasive species, climate change, and land use or management. Effects of these are addressed in the appropriate chapters of this assessment. For example, the effects of climate change and fire on terrestrial biodiversity are covered in Chapters 1 and 5 of this assessment.

There are two main facets to evaluating the sustainability of ecosystems: drivers and the effects of stressors are operating within the natural range of variability; and ecosystems are “resilient” to drivers and stressors. That means that they can have effects from drivers and stressors but continue to function and recover. Climate, fire, insects and pathogens, invasive species, vegetation succession, and vegetation management all occur simultaneously on the landscapes of the Sequoia National Forest. They influence each other. Fire affects vegetation succession. Vegetation succession affects insects and pathogen levels. Climate affects fire, vegetation succession, insects and pathogens, and invasive species. When considering ecological sustainability as influenced by drivers and stressors, it is important to consider them all together.

Important Information Evaluated in this Phase

All lands of the Sequoia National Forest, outside of the Giant Sequoia National Monument, were included in this assessment. In some sections, broader patterns for the larger bio-region were also discussed. For more detailed information on drivers and stressors in the bio-region see the July 18, 2013 snapshot of the Bio-Regional Living Assessment Chapter 3. Additional information was also obtained from the Natural Range of Variability Assessments (Safford 2013, Sawyer 2013, Merriam 2013, Meyer 2013a, b, and Estes 2013). Finally, information was drawn from several of the Science Syntheses compiled by the Forest Service, Pacific Southwest Research Station (Bytnerowicz et al. 2013, Collins and Skinner 2013, and Hunsaker et al. 2013).

Nature, Extent and Role of Existing Conditions and Future Trends

The drivers and stressors that exert primary influence on terrestrial ecosystems and people were selected and characterized in this assessment. These are: climate change, air pollution, fire, insects/pathogens, vegetation succession and management, and invasive species. Water development is an important influence on aquatic ecosystems and is covered in Chapters 1 and 2 of this assessment. Grazing is an important influence on riparian areas, and is covered in Chapters 2 and 8 of this assessment. Impacts to people are covered in Chapters 6 through 14 of this assessment.

Climate Change

Climate change is a key landscape stressor affecting long term ecological conditions. Effects of climate change are already apparent in rising minimum temperatures, earlier snowpack melting, changing stream hydrology, and increased frequency of large, severe wildfires (Safford et al. 2012). These trends are expected to continue and possibly increase in magnitude or pace.

Meyer and Safford 2010) examined long term weather station data within or adjacent to the Sequoia National Forest (6,500 to 7,000 feet elevation) and found that mean annual temperature rose between 2.6 degrees Fahrenheit, with a mean minimum (nighttime) increase of 3.7 to 4.8 degrees since the early 20th century. Increases in temperature were especially apparent at higher elevations (greater than 7000 feet) (Diaz and Escheid 2007). Freezing months declined by 1.1 to 1.4 months over this same period. In contrast, precipitation has either not changed or has increased slightly at higher elevations (Meyer et al. 2012).

Most recent climate models project temperature increases of about 9 degrees Fahrenheit in California by the end of the 21st century, with precipitation remaining similar or slightly reduced compared to today (Dettinger 2005). Most models also agreed that summers will be drier than they are currently, regardless of levels of annual precipitation. For the Sequoia National Forest, climate models, on average, project an average 7.1 degrees Fahrenheit increase by the end of the century (range: 4.0 to 11.7 degrees Fahrenheit) with a 0 to 25 percent decrease in precipitation (Gonzalez 2012, Thorne et al. 2013). Most models also project a continuously increasing rain-to-snow ratio and earlier runoff dates for the next century, with decreased snowpack (late winter snow accumulation decreases by 50 percent by 2100) and growing-season stream flow even in the higher elevation river basins (Miller et al. 2003, Moser et al. 2009).

For more detailed information see the July 18, 2013 snapshot of the Bio-Regional Living Assessment Chapter 3, lines 136-207.

Air Quality

Chapter 2 of this assessment contains detailed information on air quality and pollution for this assessment, based largely on the scientific synthesis on air quality by Bytnerowicz et al. (2013). Here, emphasis is on those aspects that affect ecosystems—critical loads. This includes impacts to vegetation and ecosystems. Critical loads are defined as a concentration of air pollution or total deposition of pollutants above which specific negative effects may occur. Critical loads are based on ecosystem responses rather than regulatory guidelines (Pardo et al. 2011). When critical loads are exceeded, ecosystems are damaged. The range of damage depends on the concentration and length of pollution exposure. Ozone and nitrogen are the primary pollutants that currently affect ecosystem condition. They are stressors.

For ozone, critical ecosystem loads or thresholds have not been developed. Bytnerowicz et al. (2003) reported that the Sequoia National Forest has a high vegetation exposure to ozone and that virtually all of the forest has been modeled as exceeding critical loads for nitrogen.

Increased exposure to nitrogen has been linked to negative ecosystem impacts such as increased invasive plant populations, altered lichen communities, and altered mountain lake chemistry with elevated nitrogen deposition rates in California (Fenn et al. 2010, Weiss 2006). Soils are buffering excess nitrogen, limiting excessive nitrogen inputs to streams (Hunsaker et al. 2013).

For more detailed information on air quality and its impact to ecological sustainability see the August 2, 2013 snapshot of the Sequoia National Forest Living Assessment Chapter 2, lines 100-149.

Fire

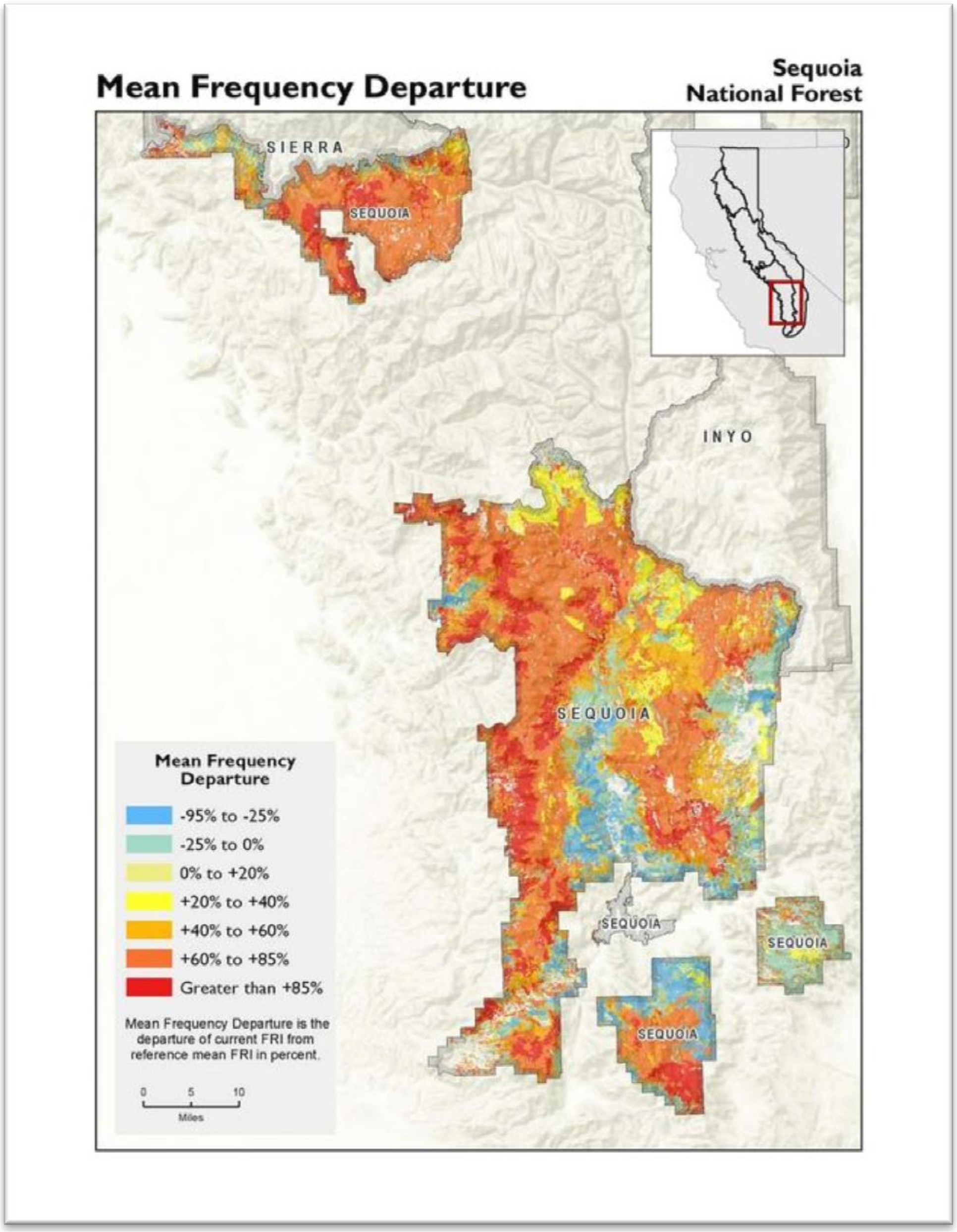
Fire has a major influence on ecosystems and communities in the bio-region and on the Sequoia National Forest. Fire has always been a fundamental ecosystem process, shaping the landscape in the bio-region. In the past, it was more extensive, widespread, and less intense. Over 100 years of fire suppression has led to detrimental effects to ecosystem integrity. At the same time, the lack of fire has significantly altered forest structure and landscape vegetation patches, increased fuel loads causing detrimental effects to communities and resources from too much high intensity fire. There are many controversies surrounding how to define issues related to fire and how to address them. Fire suppression, European-settlement activities, the wildland urban interface (WUI), and climate change have vastly changed the patterns of fire, and the ecological, social, and economic consequences of fire (Husari et al. 2006, Collins and Skinner 2013).

Prior to European settlement, fire was widespread throughout the Sequoia National Forest and the bio-region (van Wagtendonk and Fites-Kaufman 2006). Frequency, spatial pattern, and severity varied by ecosystem. The variation by ecosystem and the ecological role of fire was described in Chapter 1 of this assessment. There have been two primary changes to fire patterns in the past several decades. First, the overall frequency of fire across the landscape is greatly diminished from historic patterns. Second, the extent of high severity fires has increased beyond what is desirable by most. As described in Chapter 1 of this assessment, there is uncertainty about the natural range of variability of fire severity, particularly high severity fire.

Van de Water and Safford (2011) compared current fire frequencies with historic fire frequencies. The map below shows the mean frequency departure for the Sequoia National Forest, expressed as percent of departure in classes. The classes include:

- -95 to -25 percent areas that have more frequent fire – bright blue
- -25 percent to 0 or 0 to 25 percent + areas that have little to no deviation in fire – light blue or tan
- 20 to 40 percent + areas with some fire deficit- yellow
- 40 to 60 percent + areas with high fire deficit - orange
- 60-85 percent + or >85 percent + areas with a very high fire deficit – dark orange/red

Outside of the Giant Sequoia National Monument, different landscapes show different patterns of departures from historic fire. On the lower slopes of the western portion and some areas on the Kern Plateau, there are extensive areas of red and dark orange. This means that fires occur much less frequently now than historically. Much of the Kern Plateau, which is higher elevation and drier, has less deviation in fire. It is mostly yellow or orange. This means that fires occur somewhat less frequently now than historically but that some areas are showing evidence of fire restoration. Limited wildland urban interface (WUI) and fuel conditions have allowed restoration of fire through prescribed burning and wildfires managed primarily to meet resource benefits. Most of the lowest elevations on the Sequoia National Forest, in foothill chaparral, grassland, and oak woodlands are depicted in blue. This means that there is more frequent fire now than historically. This excess of fire may lead to issues related to non-native plant invasions, tree regeneration failure, elevated soil erosion, and loss of ecosystem integrity in lower elevation ecosystems. These types of impacts are currently observed in southern California's national forests. This is due to the proximity to the WUI (greater probability of human-caused fire starts), a longer and expanding fire season at lower elevations, and flashier, more continuous chaparral and grass fuels.



Current and historic fire frequencies on the Sequoia National Forest

For more detailed information on the fire frequency departure, see the August 2, 2013 snapshot of the Sequoia National Forest Living Assessment Chapter 1, lines 150-153.

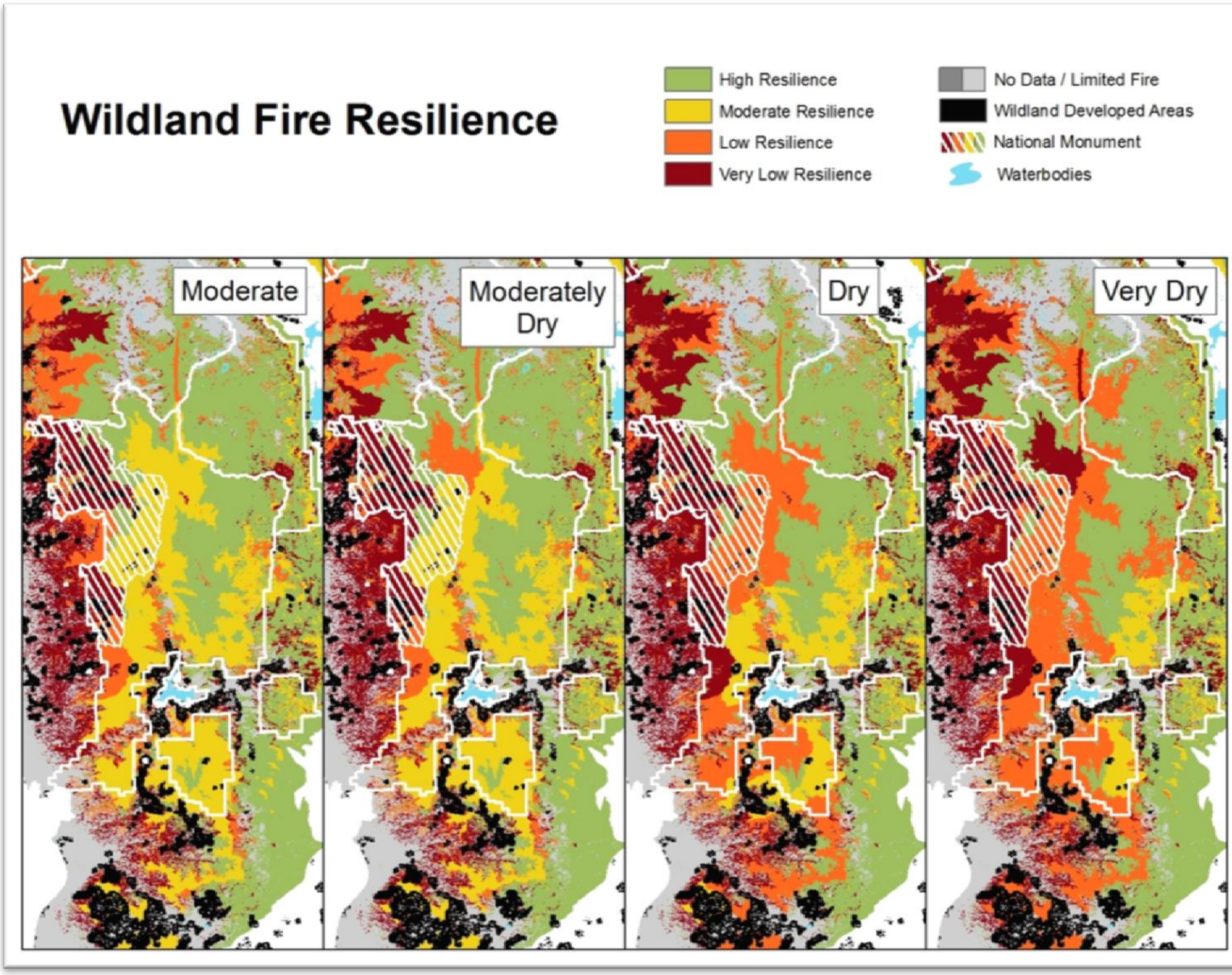
Total area burned annually is far below historic levels (Stephens et al. 2007, North et al. 2012). The result of these changes is denser, more uniform forests and shrubfields (Collins and Skinner 2013). This in turn has led to more uniform, high severity fires (van Wagtendonk and Fites-Kaufman 2006, Miller et al. 2009, Collins and Stephens 2010, Miller and Safford 2012).

A bio-regional analysis of the resilience of vegetation to fire in different weather conditions was conducted (Fites-Kaufman et al. 2013). Resiliency reflects the potential fire behavior and effects to vegetation. This is one way to measure the relative "stress level" of changes in fire.

Potential fire resiliency for four different weather scenarios is shown on the map below. The model parameters, including weather, are described in Fites-Kaufman et al. (2013). The assessment did not include changing weather conditions with terrain or daily fluctuations. That would have resulted in more variable fire effects and increased the uncertainty of the results. The purpose of this fire resilience assessment was to gain a relative understanding of the potential effects across a range of typical fire season conditions under current climate conditions.

The map below shows the results of the fire resilience assessment. It is of four "tiled" maps, each depicting different weather scenarios. Weather conditions go from moderate on the left, to moderately high, high, and very high on the right. There are six categories of resilience mapped: gray is sparsely vegetated or unknown areas thought to have little or no fire potential; light green denotes high fire resilience; yellow is moderate fire resilience; orange is low resilience; red is very low resilience; and the black dots represent developed areas, or wildland urban interface. The Giant Sequoia National Monument has white diagonal lines going over the fire resiliency, since this area is not included directly in this assessment.

The left map depicts results in moderate fire weather. These would be typical early summer fire conditions. Here most of the upper montane zone is yellow, which is moderate resilience. In contrast, the low and mid-elevation mixed conifer, pine, and foothill areas are mostly low to very low resilience under all weather conditions. Under hotter, drier and windier conditions (high and very high weather in the lower maps), all the mid and lower elevations have low to very low resilience to fire. This means that most of the landscape will burn at high intensities with high severity effects. For forests, a high level of tree mortality will occur. For shrublands, a high level of above ground consumption of foliage and branches will occur. Areas that are depicted as moderate to high resilience will burn with more of a mosaic of intensities and effects. In the upper montane red fir forests, occurring above the mixed conifer as large or small islands on mountain tops, resilience is low to moderate, depending on weather conditions. The Jeffrey pine and eastside mixed conifer forests found on the Kern Plateau have variable fire resilience. These forests tend to be drier and more open, with slower rates of fuel accumulation. Prior to fire suppression, their resilience was high. The relatively greater resilience in these dry forest ecosystems of the Kern Plateau compared to similar forests to the south and west indicates that these forests are more resilient to fire under all fire weather scenarios. This greater resiliency may reflect the lower fuel loading, lower moisture stress, and greater use of wildland fire for resource benefit in forest ecosystems on the Kern Plateau. At the same time, conditions are drier and little increases in weather severity can result in increases in fire intensity. There is more uncertainty in fire resilience estimates in this area as a result. In all weather conditions, highest elevations including lodgepole pine, upper montane chaparral, sparsely vegetated areas, and subalpine woodlands have moderate to high resilience.



Wildland Fire Resilience on the Sequoia National Forest under four fire weather scenarios

In contrast, the higher elevation areas on the Kern plateau, the north eastern half of the forest, are mostly high to moderate resilience, even in the driest conditions. This was borne out during a series of recent wildfires managed primarily to meet resource benefits there including Lion in 2011, Albanita-Hooker in 2003, and Crag in 2005 (Vaillant 2009, Ewell et al. 2012). The distribution of severity by vegetation type was discussed in Chapter 1 of this assessment, and was generally within the natural range of variability.

Along with changes in vegetation and fire suppression, human populations have increased and impacted fire suppression and restoration. In the fire resilience maps above, the black areas show human development, towns and infrastructure. Together, these are referred to as the wildland urban interface (WUI). Development is concentrated along the western edge at lower elevations. There are some recreation developments at mid-elevations such as around Hume Lake and Sequoia Lake.

The combination of accumulated vegetation and fuels in the wildlands with increased population contributes to increasing threats to communities, as well as increased fire suppression costs throughout the western United States (California Forest and Range Assessment 2010, Toman et al. 2013, Wildland Fire Leadership Council Cohesive Strategy 2013, Ecological Restoration Institute 2013). The extensive wildland urban interface (WUI) in the bio-region has resulted in changes to fire management, including choice of strategies and expenditures during uncontrolled wildfires (Calkin et al. 2005, Canton-Thomson et al. 2008). Research has shown that fuels in the "home ignition zone" and ignitability of building materials are most critical to whether or not structures burn in the wildland urban interface (Cohen 2001, 2003, 2004, Reinhardt et al. 2008). Investigations of recent catastrophic fires in the WUI, where many structures burned, show that most of the damage occurs during the most severe fire weather conditions (Menakis et al. 2003). Fires under these conditions have rapid growth rates and/or high intensities (Reinhardt et al. 2008). An example in the bio-region is the Angora Fire in South Lake Tahoe in 2007 (Safford et al. 2009). Despite fuel hazard reduction treatments in the WUI, 254 homes were destroyed (Safford et al. 2009). Similar outcomes would be expected with some fires on the Sequoia National Forest. In Chapter 1 of this assessment, the amount of high severity fire from an array of recent fires on the Sequoia National Forest was shown. Some of these fires occurred near or in the WUI, including the Piute and Bull fires. These burned near the communities of Bodfish, Havilah, and Riverkern and had a high amount of high severity. High severity effects to vegetation are often, but not always, directly related to high intensity, more difficult to control fire. These fires require intensive firefighting efforts to keep out of the WUI. The Shirley Fire this year burned next to the community of Alta Sierra and the Shirley Meadow Ski Resort next to the Sequoia National Forest. A rainstorm kept the fire behavior minimal. In other times, that may not be the case.

In a national risk assessment, the Sierra Nevada mountain range was identified as one of the highest risk areas in the country (Cohesive Strategy2013). A more refined risk assessment is under development for the Sequoia National Forest, and will be used during forest plan revision.

These types of fires put more firefighters at risk (Stockmann et al. 2010). In 2006, five firefighters were killed protecting WUI structures (Stockmann et al. 2010). In 2003, fifteen people, including one firefighter, were killed in association with the Cedar Fire in southern California. Tragically, this year 19 firefighters were killed while suppressing a fire in Arizona. As a result of these newer findings, the new Cohesive Fire Strategy emphasizes fire adapted communities, fire resilient wildlands, and risk-based fire management.

Future projections indicate that climate will continue to change and magnify the fire risk to communities, as well as increase the likelihood of more intense and faster growing fires in the wildlands (McKenzie et al. 2004, Westerling et al. 2006, Westerling and Bryant 2008, Westerling et al. 2011). Longer fire seasons and drier and hotter fire conditions have already been noted over the last decade (Safford et al. 2012). Moreover, climate models for the southern Sierra Nevada project show increased fire probability and impacts to terrestrial ecosystems, including the Sequoia National Forest (Moritz et al. 2013, Schwartz et al. 2013).

Fires do not recognize land ownership boundaries. The Cohesive Fire Strategy (2013) recognizes the importance of cooperative relationships among land managers and owners in addressing fire issues. On the Sequoia National Forest, there is good cooperation and initiative among different groups and communities. There are four Fire Safe Councils: Sequoia, Alder Creek, Kern Valley, and Highway 180. Cooperative relationships exist with Tule River Indian Reservation, CalFire, Kern County Fire Department, Tulare County Fire Department, Yosemite and Sequoia-Kings National Park, Central California District of the Bureau of Land Management, San Joaquin Valley Unified Air Pollution Control District, Great Basin Air Pollution Control District, Eastern Kern Air Pollution Control District, California Air Resource Board, Environmental Protection Agency, and the U.S. Fish and Wildlife Service.

The Sequoia National Forest is adjacent to 41 communities at risk from wildfire. An assessment of current conditions in the wildland urban interface is not possible at this time because there is no single database of fire hazard and community protection treatment projects or conditions.

Insects and Pathogens

Many forested ecosystems in the Sierra Nevada, from the foothills to the highest elevations, show serious symptoms of forest health stress. In many areas, past management activities have resulted in overly dense stands, imbalances in diversity of age class, and altered forest structure and composition. This alteration from historical conditions has resulted in increased susceptibility to insects, pathogens, and weather induced stresses. Ecosystems which are currently outside their natural range of variability are less resilient to diseases and attack by insects. Changing climates could also alter insect and pathogen lifecycle development and behavior. Bark and engraver beetles, defoliators, root diseases, mistletoes, and the introduced fungus which causes white pine blister rust are important forest insects and diseases throughout the Sierra Nevada Range. With the exception of a few introduced insects and pathogens, forests in the Sierra Nevada have the same insect and disease associates they had 100 years ago. The difference is the scale of interaction between insects, pathogens, and their hosts in both space and time. Although large insect outbreaks are known to have occurred historically, the landscape patterns of vegetation often resulted in disturbances that were brief and spatially confined.

Historically, the most significant widespread effect on vegetation has been conifer mortality associated with bark beetles, severe moisture stress, and fire. The highest numbers of acres with mortality have been attributed to bark beetles. Conifer mortality associated with insects tends to increase whenever annual precipitation is considerably less than historical average for extended periods (drought). Trees that are stressed by inadequate moisture levels have weakened defense systems, leaving them highly susceptible to attack by bark beetles. The potential for disease infection and infection intensity increases when trees become more stressed. High levels of conifer mortality have been recorded numerous times in association with extreme or protracted droughts in the Sierra Nevada Range (California Forest Pest Condition Reports 1960-present). In addition, warming temperatures have increased the probability of bark beetle outbreaks in the near future, especially in high elevation, pine-dominated forests (Meyer 2013b, Hicke et al. 2006).

Vegetation Succession, Land Use and Management

Trees, grasses and shrubs grow and change over time in a non-seasonal and directional fashion. This is called vegetation "succession". Historically, fire played an important role in shaping vegetation succession. It kept vegetation density low and more variable and favored dominance by fire resilient species, such as ponderosa pine and black oak. Native Americans used fire to benefit food sources and life necessities such as basketry materials. This interaction changed dramatically with European settlement.

Vegetation management can be considered both a driver and stressor to ecosystems. Changes in land use have shifted over time from early settlement activities, fire suppression and timber harvest in the early and middle part of the 20th century. Over the last 30 years, more emphasis has been placed on protecting wildlife habitat and other land uses such as recreation. All of these changes have affected vegetation succession. This history of vegetation management is important to understanding current patterns of vegetation succession and future trends. Current levels of vegetation restoration are very low compared to rates of vegetation growth (North et al. 2012). This has resulted in denser vegetation that is more susceptible to drought, large high intensity fire, and insect and pathogen outbreaks.

Native American Management

Native Americans used fire to manage for varied beneficial uses for thousands of years. In addition to ignitions by lightning, Native Americans used fire to manage for food, basketry, hunting, travel ways, and fire hazard (Anderson and Moratto 1996, Anderson 2006, Lake and Long 2013). Some areas were burned every year or several years, where particularly important food sources were present (Anderson 2006). This included areas around and in meadows and riparian areas. Importantly, Native Americans did not suppress fires or if they did, not on a widespread basis. There are growing efforts by Native American tribes in and near the Sequoia National Forest to restore fire for cultural and ecosystem benefits. For more information, see Chapter 12 of this assessment.

European Settlement

European settlement in the bio-region greatly intensified with discovery of gold in the Sierra Nevada in 1848 (Beesley1996). Along with mining came intensive logging to fuel steam-generated equipment and to build housing. There was also extensive grazing for livestock. The timber industry officially started in the mid-1800s in the foothills at lower elevations near the mills they were supplying (McKelvey and Johnston 1992). Early logging focused on large diameter trees. By the late 1800s and early 1900s, owners moved their sawmills to places like Hume Lake, where large diameter trees including sugar pine and giant sequoias were cut to make shakes and grape stakes (McKelvey and Johnston 1992). These actions resulted in substantial reductions of sugar, ponderosa and Jeffrey pine forests.

Sheepherders burned extensively at high elevations in the fall on their way down from the mountains, presumably to improve forage (Sudworth 1900, Leiburg 1902, Vankat 1970, McKelvey and Johnston 1992). Ranchers in the foothills reportedly used fires to increase forage production and enhance livestock access (Merriam 2013). Miners and other early settlers caused accidental fires.

For more detailed information see the Natural Range of Variability Assessments (Safford 2013, Estes 2013, Meyer 2013a and 2013b, Merriam 2013).

Management from the 1930s to 1980s

Starting in the early 1900s, fires were actively suppressed with the intention of "protecting forests". Logging in the mid-1900s focused on selective harvest of larger trees, and on regeneration in the 1980s (Verner et al. 1992, Helms and Tappeiner 1996).

Over the last century, with good intent but unforeseen consequences, most fires were rigorously suppressed. For at least half a century, this suppression was successful (McKelvey et al. 1996, Husari and McKelvey 1996, Husari et al. 2006). This fire suppression has resulted in increased vegetation density and uniformity, an increase of less fire tolerant trees, and understory fuel loads resulting in increased fire potential (van Wagtendonk 1985, Stephens and Moghaddas 2005, Stephens 2005, van Wagtendonk and Fites-Kaufman 2006, North et al. 2009).

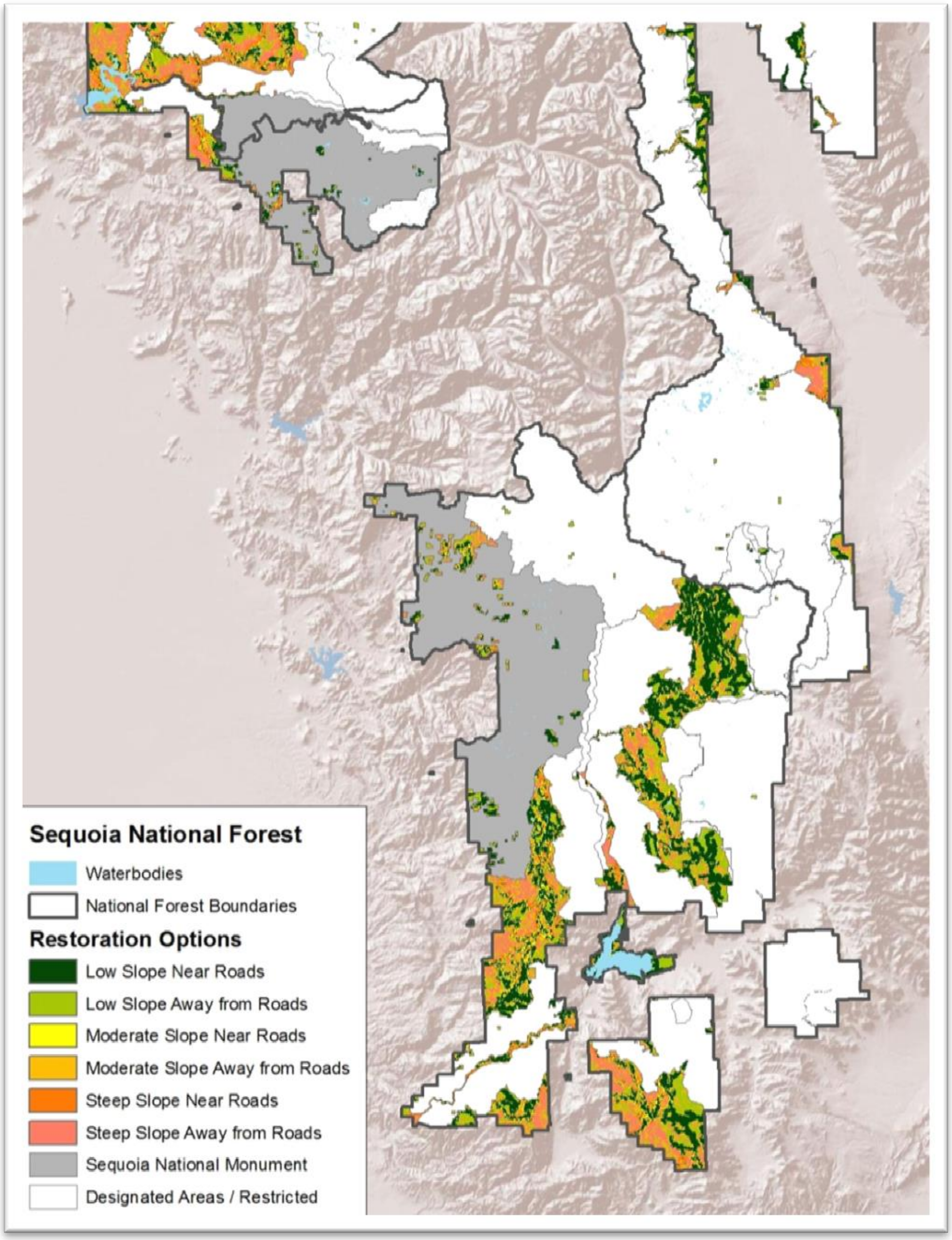
Current Management

In the early 1990s, concern for the California spotted owl and other ecosystem impacts generated substantial changes in land use on federally managed lands. Harvest of large trees was essentially eliminated, and the emphasis shifted to smaller diameter trees. Vegetation management around nests or den sites for the California spotted owl, goshawk, fisher, and marten was heavily restricted. At the same time, a growing concern for the cumulative effects of past management and fire suppression increased the focus on restoring fire and reducing forest densities and surface fuel accumulations. In the 1990s under CASPO (California Spotted Owl) guidelines, emphasis was on maintaining large trees and reducing fire hazard. More recently, reduction in canopy cover in owl home ranges has been limited (USFS 2001).

The effects of fire suppression on increasing fuels in the Sierra Nevada (van Wagtendonk 1985, Stephens and Moghaddas 2005, Stephens 2005, van Wagtendonk and Fites-Kaufman 2006, North et al. 2009, Valliant et al. 2013) and elsewhere in the western United States has been well documented (Reinhardt et al. 2008) and has been considered in past forest plans and forest plan revisions (USFS 2001). More recently, changes in climate have been overlaid on increased fuel conditions, contributing to undesirable fire effects to ecosystems and communities. An estimate of the area under different "condition classes" was developed by the Forest Service in 2008. Condition Classes 2 and 3 represent areas where vegetation density and fuels are substantially greater than historic conditions. Nearly 25 percent of the Sequoia National Forest was estimated to be in Condition Class 1. Similarly, nearly 25 percent was in Condition Class 3, the worst condition possible. The remainder was in Condition Class 2 (50 percent). The areas in the best condition are in the subalpine zone and the areas in the worst condition are in the mixed conifer and pine forests.

The resilience of landscapes to large, high intensity fire or drought and insect/pathogen outbreaks varies considerably across the Sequoia National Forest. The variation is due to both differences in the landscapes (vegetation type and environment) and management history. The productive western slopes are least resilient and have been described in the Giant Sequoia National Monument Plan. Outside of the monument, the lower elevations and southern portions have low to very low resilience. Here fire season is longest, conditions driest, and vegetation most changed from historic conditions. It is denser and more susceptible to fire and drought. At higher elevations on the Kern Plateau, resilience is dominantly moderate but also low in large areas. This is a reflection of both extensive restoration of fire in subalpine and upper montane wilderness landscapes, and the drier environment and shorter fire season that supports lower fuel loading and more drought-tolerant vegetation. Vegetation change (e.g. biomass accumulation) is slower under these conditions and there has been relatively less change since European settlement and fire suppression. Aside from the Kern Plateau, restoration is proceeding at a pace and scale that is inadequate to address the problem in a timely way.

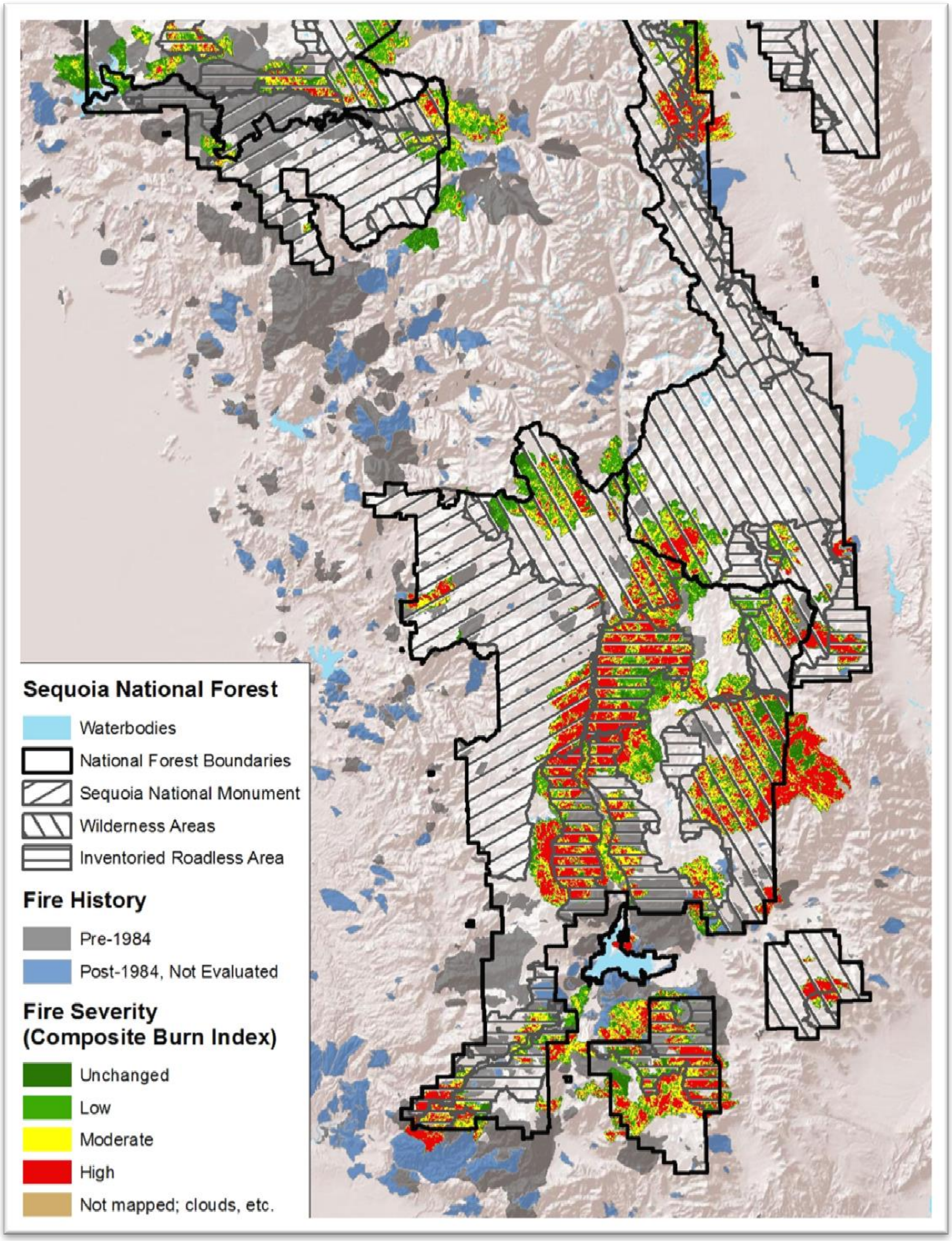
In the map below, areas with different potential arrays of restoration actions are displayed. These include: areas designated for special management such as wilderness, wild and scenic river corridors, research natural areas, or designated roadless areas with specific restoration guidelines shown in white; potential areas to treat near roads (less than 1,000 feet) and slopes less than 30 percent (dark green) or 30-40 percent (yellow); potential areas to treat near roads with slopes greater than 40 percent (dark orange near roads and peach away from roads); and potential areas to treat with gentle slopes (less than 30 percent) away from roads. The Giant Sequoia National Monument is noted in gray and is not included in this discussion. Over half of the area outside of the monument is shown as white, in specially designated areas. The remainder occurs in a wide strip to the east of the Kern River, running north and south, immediately below the monument along the western portion of the forest, and the lower half of the Scodie Mountains. The area east of the Kern River is on the Kern plateau, is mostly gently to moderately sloping and is operable by equipment for restoration. The northern half of this area has the majority near roads (about 80 percent) and the remainder has limited areas near several road systems running north-south. The section outside of designated areas to the south of the Giant Sequoia National Monument is mostly steep (greater than 75 percent of area) and away from roads. About 20 percent is low or moderately sloped near roads. The pattern is similar in the Scodie mountain area below Lake Isabelle. Here there is about one fifth of the area outside of designated areas that has a low slope but is away from roads. More detail on the designated areas can be found in Chapter 15 of this assessment.



Restoration areas on the Sequoia National Forest

The map below displays fire history for the Sequoia National Forest and for fires since 1984, patterns of fire severity (one-year post-fire, composite burn index). Fire severity has been mapped for fires since 1984, using satellite imagery (Miller and Thode 2007). These severity classes are from the Composite Burn Severity Index, which is measured one-year post-fire and reflects a combination of mostly fire and some soil effects (Miller et al. 2009). The levels are denoted by the following color scheme: low is green, moderate is yellow and high is red. On top of the fires, widely spaced, gray lines show different land designations including: right slant for the Giant Sequoia National Monument, left slant for designated wilderness areas, and horizontal lines for inventoried roadless areas.

Fires have burned across more than half of the forest. The majority of these areas is in wilderness or inventoried roadless areas. The gray patches are those that burned before 1984 and are concentrated in the southern one-third of the forest, around Lake Isabella and the northern half of the Piute Mountains. Since 1984, a combination of uncontrolled wildfires and fires managed for resource objectives in wilderness areas have occurred, covering between one-fifth and one-third of the forest. Most of the fires in the wilderness areas on the eastern third of the forest have been managed for restoration objectives (about 50,000 acres). These have a mix of fire severities shown as varying mosaic patterns of red (high severity), yellow (moderate), and green (low). These areas tend to have less than one-third as high severity. In contrast, there are a number of larger fires, running north and south along the Kern River Canyon and vicinity that are dominantly high severity (red). These areas tend to have more than half high severity. Similar are fires at the eastern edge of the forest on the Kern Plateau in the middle of the forest and the Piute Mountains to the south.



Fire history on the Sequoia National Forest

The rate of restoration using both mechanical and fire means is highly varied across the Sequoia National Forest. This reflects the differences in management designation, accessibility, and vegetation type. In the designated wilderness and high elevation subalpine and upper montane forests and chaparral to the east of the Kern River, there has been extensive ecological restoration through managed wildfire. A little over

50,000 acres have been treated with wildfires managed primarily to meet resource benefits since 2001. The Sequoia National Forest has the most active and extensive fire restoration program of the national forests in California. This is despite enormous challenges in air quality. Air quality issues have been addressed proactively with regular, direct communication and collaboration with air quality regulators, and systematic, real time air quality video and sensor monitoring. As discussed in Chapter 1 of this assessment, most of the areas burned at higher elevations are beneficial ecologically.

Mechanical treatment and restoration activities of all kinds have been much more limited in lower elevation areas to the south and west. Thinning has occurred on a little over 3,600 acres. Prescribed burning has occurred on 6,200 acres, either as piles or broadcast burning. Some of these areas overlap with the thinned areas and others are separate. There have been several large, high intensity fires that have resulted in extensive areas of high severity effects. Many of these areas have had invasion by annual, non-native grasses, making long term restoration more difficult, time-consuming and expensive.

There are multiple and complex reasons behind the limited restoration. These include smoke management regulations, limited budgets, environmental concerns, and the economics of mechanical treatments.

Illegal Land Uses

Recent research (Gabriel et al. 2012) has shown that rodenticide poisons, such as those distributed through illegal marijuana growing operations, can have detrimental impacts on species such as mice, wood rats and squirrels. It can increase their vulnerability to parasites, pathogens, or predators, or result in death (Gabriel et al. 2012). This in turn can detrimentally influence the wellbeing of hunted and non-hunted wildlife populations, as well as have potentially negative effects on people who consume those species. A large proportion of fisher carcasses recovered between 2007 and 2011 in the southern Sierra research sites showed evidence of exposure to one or more rodenticides (Thompson et al. 2011). More than 300 illegal marijuana sites have been located in these research areas since 2002.

Invasive Species

The influx of non-native species of animals and plants since the first Europeans arrived in California has changed the ecosystems of the Sierra Nevada. This continues to be a major and increasingly important stressor on the Sequoia National Forest. Invasive species includes all life forms including plants, animals, invertebrates, and fungi.

Invasive Plants

The foothill zone has extensive areas with non-native grasses. Non-native annual grasses were imported when Europeans arrived hundreds of years ago. These include brome, wild barley, wild oats, and annual fescues. Star thistle is also prevalent. The exact area is unknown.

Non-native plants make up a smaller proportion of all species in each major vegetation zone as elevation increases. An example from nearby Yosemite National Park is given by Botti (2001), who wrote that 23 percent of plant species were non-native in the lower elevation chaparral/oak woodland zone of Yosemite, 13 percent of species in the mixed conifer zone were non-native, 5 percent of species in the upper montane zone were non-native, and only 0.5 percent were non-native in the subalpine zone. The alpine zone had no non-native species documented. Similar results were reported by Keeley et al. (2003) in the Sequoia and Kings Canyon National Parks. Foothill chaparral showed increases in non-native plants for several years after fire. This pattern appears similar on the Sequoia National Forest.

Invasive Animals

There are several known invasive animals near or observed in the Sequoia National Forest. The barred owl is native to the east coast of the United States and has migrated west and south. It hybridizes with the California spotted owl, jeopardizing its genetic integrity (Keane 2013). It has been observed just to the north of the Sequoia National Forest. It is unknown how fast they are progressing south. The non-native red fox is present, as are feral pigs and starlings. Feral pigs can disrupt native vegetation but are present to an unknown level. Starlings are nest parasites and tend to occur near developed areas. It is unknown how extensive they are.

Invasive Invertebrates and Fungi

Invasive invertebrates such as the zebra mussel are impacting aquatic ecosystems. More information on aquatic invasive species is described in Chapter 1 of this assessment. White pine blister rust has impacted white pines in the bio-region for decades. For more information on its impacts to native trees, see the discussion on Natural Range of Variability in Chapter 1 of this assessment.

Contribution the Plan Area Makes to Ecological, Social or Economic Sustainability

In 2004, the Forest Service produced a national report on Sustainable Forests (USFS 2004). That report included a summary of the current condition of forests, based on a variety of ecological, social and economic indicators of sustainability. In defining ecological sustainability, the following was included from Helms (1998):

> ...the capacity of forests, ranging from stands to ecoregions, to maintain their health, productivity, diversity, and overall integrity, in the long run, in the context of human activity and use.

There are two main facets to evaluating the sustainability of ecosystems: drivers and the effects of stressors are operating within the natural range of variability; and ecosystems are “resilient” to drivers and stressors. That means that they can have effects from drivers and stressors but continue to function and recover. Climate, fire, insects and pathogens, invasive species, vegetation succession, and vegetation management all occur simultaneously on the landscapes of the Sequoia National Forest. They influence each other. Fire affects vegetation succession. Vegetation succession affects insects and pathogen levels. Climate affects fire, vegetation succession, insects and pathogens, and invasive species. When considering ecological sustainability as influenced by drivers and stressors, it is important to consider them all together.

Natural Range of Variability

Overall, ecosystems on the Sequoia National Forest are outside of the natural range of variability in terms of fire, insect/pathogens, air quality, invasive species, and vegetation succession. The exception is in areas in the Kern Plateau where fire has been mostly restored, primarily in upper montane and subalpine ecosystems.

In the table below, the conditions of these drivers and stressors are summarized using similar elements as described in the National Report on Sustainable Forests (2004, 2010). The deviations from the natural range of variability are great for foothill and montane areas (mixed conifer, oak and pine), moderate for upper montane (red fir and Jeffrey pine), and low for subalpine and alpine areas for all characteristics (fire, vegetation succession, insects/pathogens, air quality). The trend is for these characteristics to continue to deviate from the natural range of variability, and to deviate more because of the low rate of restoration vegetation management. This includes fire managed for resource benefit.

Summary of drivers and stressors

Characteristic	Condition	Trend
Area affected by insects and pathogens beyond natural range	Vegetation mostly outside of natural range. Dense forests and climate change increase susceptibility to large outbreaks.	Continued. Restoration far below rates needed to restore. Climate change will make worse.
Area affected by air pollutants that may cause negative effects	Poor and worsening. Especially lower and middle elevations.	Continued, although some air control measures have improved conditions some.
Area affected by invasive species	Poor in foothill zone, extensive non-native grasses. Some invasions in mid to higher elevations.	Continued. Difficult to restore foothills. Climate change enhances invasions, especially at mid to higher elevations.
Area with fire condition class outside of natural range	Mostly outside or range (except subalpine/alpine and upper montane in substantial portions of the Kern Plateau)	Continued. Restoration far below rates needed to restore. Warming and longer fire season is making problem worse. Use of wildfires managed primarily to meet resource benefits in the Kern Plateau has improved conditions in this area.
Area with vegetation condition outside of natural range	Mostly outside or range (except subalpine/alpine)	Continued. Restoration far below rates needed to restore. Climate change will make worse.

Resilience

Ecosystem resilience can be difficult to characterize. In essence, it is the ability of an ecosystem to absorb changes from drivers and stressors, and still maintain function (biodiversity and processes such as carbon cycling). Over thousands of years, drought has occurred in the Sierra Nevada. A severe drought has not been experienced recently on the Sequoia National Forest or in the bio-region. However, a severe drought is inevitable and with current trends in climate, the effects are likely to magnify with longer, drier summers and less snowpack already evident. Predicted trends are that climate will continue to change and magnify the fire risk to communities, as well as to increase the likelihood of more intense and faster growing fires in the wildlands (McKenzie et al. 2004, Westerling 2006, Westerling and Bryant 2008, Westerling et al. 2011). Longer fire seasons, and drier and hotter fire conditions have already been noted over the last two to three decades (Safford et al. 2012).

Given that the current condition of vegetation is denser and structurally more homogenous than the natural range of variability (Meyer 2013a and b, Safford 2013) it is likely that the foothill and montane landscapes on the Sequoia National Forest will not be resilient to drought, high severity fire, and insect and pathogen outbreaks. Air pollution is currently at levels where there is impaired function for many ecosystems. This weakens vegetation, making it more susceptible to drought and insects and pathogen related die-back. Widespread increased tree mortality has already been reported (Van Mantgem et al. 2009). Fires are more likely to be more uniformly severe across large areas. Severe fire has always occurred. In the past, however, vegetation was more heterogeneous and as a result the fires were patchier.

In the foothills, invasive grass species have dominated large areas since European settlement. More recently, they have spread along roads, and sometimes with fires in montane chaparral and forests. Invasive species may be enhanced by climate change. These invasive grasses also change the fire regime. In chaparral, invasive annual grasses shift the fire regime to a more frequent one.

Overall, the foothill and montane landscapes have low resilience. The upper montane landscapes have moderate resilience. Subalpine and alpine ecosystems have high resilience, although they may be particularly vulnerable to warming climate and reduced snowpack, and introduced diseases such as white pine blister rust.

Information Gaps

An assessment of current conditions in the wildland urban interface is not possible at this time because there is no single database of fire hazard and community protection treatment projects or conditions.

Chapter 4: Assessing Carbon Stocks

Forests play an essential role in global carbon storage, by removing carbon dioxide (CO_2) from the atmosphere and by storing carbon as biomass within ecosystems. Increases in atmospheric CO_2 over the last century have been linked to rising temperatures, and because forests absorb CO_2, they play an important role in regulating climate. In turn, changes in climate, including precipitation and temperature, influence the rates of carbon uptake and loss from an ecosystem. As a result, it has become increasingly important to understand the feedback mechanisms between carbon uptake and forests to ensure the maintenance of healthy and productive ecosystems.

Carbon stock is a term used here to describe the total pool of carbon in an area, including live and dead biomass, and above and below ground carbon. Atmospheric CO_2 is specifically addressed in Chapter 2 of this assessment, and is considered here only as it is linked to forest carbon stocks. Other issues that influence carbon stocks, including the harvest of wood products, fire, disease, and climate, are covered in more detail in other chapters of this assessment. In this chapter, the focus is on assessing the issues that associate carbon stocks with climate change.

Important Information Evaluated in this Phase

One of the goals of the 2010-2015 USDA Strategic Plan is to ensure National Forest System (NFS) and private working lands are conserved, restored, and made resilient to climate change (USDA 2010). The Forest Service roadmap for responding to climate change identifies the assessment and management of carbon stocks as a major element of its plan.

The 2006 Global Warming Solutions Act (CA Assembly Bill AB 32) requires California to reduce greenhouse gas emissions to 1990 levels by 2020, and to identify the most feasible and cost effective methods to reduce emissions. Reductions may be achieved through a variety of methods, including capping greenhouse emitting sectors (manufacturing, energy production, transportation) and issuing emissions allowances that will achieve these greenhouse gas reductions. Because California forests were identified as a carbon sink, an annual sequestration target of 5.2 Tg (teragrams) of carbon per year through 2020 was identified for the forest sector. This is to be achieved through sustainable management practices, including reducing the risk of catastrophic wildfire, and the avoidance or mitigation of land use changes that reduce carbon storage. Though non-binding, the plan states that, “The federal government must also use its regulatory authority to, at a minimum maintain current carbon sequestration levels for land under its jurisdiction in California”.

As a result, the Forest Service evaluates current and potential net annual loss or gain in the assessment area’s carbon storage, which determines whether the area is a source or sink for carbon. The feedback mechanisms between carbon storage and long term site productivity in the assessment area are also assessed. Carbon stocks and accounting can be performed in multiple ways. The United States adopted standard accounting and reporting protocols for forests and forest products, adapted from the U.S. Department of Energy (DOE) 1605(b) methodology, Technical Guidelines for Voluntary Reporting of Greenhouse Gas Program, Chapter 1. These forest carbon estimates included live trees, understory vegetation, standing dead trees, forest floor, down dead wood, soil carbon, harvested wood in use, and landfilled wood products (EPA 2004).

For more detailed information on the information evaluated see the snapshot of the Bio-Regional Living Assessment Chapter 4 lines 40-121.

Nature, Extent and Role of Existing Conditions and Future Trends

A comprehensive review of the carbon cycle can be found in Janzen (2004). Basically, CO_2 in the atmosphere is absorbed by vegetation, which converts CO_2 to biomass in the process of photosynthesis. The carbon present in biomass, including leaves, stems, and roots, is converted to litter and dead wood. Carbon dioxide is emitted back into the atmosphere by plants and animals during respiration, and is released from microbes that decompose litter and dead wood. Carbon can also be removed from an ecosystem by wood harvesting, grazing, fire, transport of soil and litter in streams or floods, and by the transport of soluble carbon molecules in soil.

The term “carbon sequestration” as used here refers to the process of carbon uptake and storage that is carried out primarily by vegetation. This forest vegetation includes carbon estimates for live trees, understory vegetation, standing dead trees, forest floor, down dead wood, soil carbon, harvested wood in use, and landfilled wood products (EPA 2004).

Estimates have been calculated for the carbon sequestered on the forestlands of the Sequoia National Forest. Forestlands are defined here as being composed of at least ten percent cover by live trees of any size, including land that formerly had such tree cover and that will naturally or artificially be regenerated (Smith et al. 2004). A nationwide study of estimates of forestland live tree, understory vegetation, standing dead tree, forest floor, down dead wood, soil carbon stocks was conducted by Heath et al. (2011), using ground-based datasets from the Forest Service Forest Inventory and Analysis program, and summarized data by NFS region and forest. These estimates did not include harvested wood in use or landfilled wood products.

The table below (Heath et al. 2011) shows forestland carbon stocks within the assessment area. Forest carbon density is generally greatest in the central sub-region of the assessment area, and lowest in the eastern sub-region. This can be generally attributed to climatic patterns that affect ecosystem productivity, and in turn carbon storage. As can be seen, the Sequoia National Forest has the seventh highest forest carbon density in the bio-region.

Carbon statistics for NFS lands, by national forest (2004 and 2006)

Sub-region	National Forest	Forest carbon density(Mg C/ha)	Forest area (1000 ha)	Total forest C +/- 95 percent CI as percentage of mean (Tg)	Above ground live tree C density(Mg C/ha)
Central	Eldorado	281.9	232	65+/-20	135.4
South, East	Inyo	138.9	456	63+/-15	52.6
South, East	LTBMU	200.5	75	15+/-49	86
North, East	Modoc	142.9	517	74+/-15	38.8
North	Plumas	252.2	454	114+/-13	116.5
South	Sequoia	203.6	393	80+/-17	88.6
Central	Sequoia	244.3	455	111+/-14	115.5
South	Stanislaus	235.3	320	75+/-18	106.5
Central	Tahoe	242.1	327	79+/-17	111.1
North	Lassen	213.9	420	90+/-15	91.2

Other important landscapes contributing to carbon sequestration are shrublands and meadows. There are no specific Sequoia National Forest estimates for carbon in these landscapes but studies have shown that these are important areas for sequestration. Meyer (2012) summarized findings regarding carbon storage in cold desert shrublands. The deep rooting systems and high root-to-shoot ratios of these ecosystems results in large carbon reserves, despite the fact that productivity in these areas is low compared to most forested lands, and that their role in the carbon cycle is assumed to be minor. Soil carbon dominates the terrestrial carbon pool, exceeding carbon stocks held in plant biomass nearly five-fold (Janzen 2004). Similar to shrublands, meadows may play a significant role in the carbon cycle, primarily due to their extensive below ground biomass. In addition, the role of meadows in the carbon cycle is magnified because meadows are typically associated with greater soil moisture compared to surrounding landscapes, and soil moisture is correlated to greater ecosystem productivity and respiration (Norton et al. 2006).

There are some key factors influencing carbon sequestration on the forest. Climate change that affects the growth of vegetation will impact the amount of carbon stored on the forest. Much of the carbon now accumulating in these forests is being added in the form of ladder fuels, which carry fire from the lower vegetation canopy to the upper canopy of trees. As mean fire size and burn severity has increased with vegetation changes, fire has come to play an increasingly important role in carbon storage (North 2013). Grazing also influences the carbon storage of ecosystems through forage removal, hoof action and activity that affects soil and livestock waste. Vegetation management for fuels treatments can reduce fire severity and consequent carbon release, but also reduce forest carbon stores in the short term (North 2013). Insect and disease outbreaks can convert forests from carbon sinks to sources (Kurz et al. 2008, Pfeifer et al. 2011). Finally, predicted increases in the population of California will have an influence on carbon storage and sequestration in the assessment area. The primary impact will be through continued carbon emissions and subsequent rising temperatures, which influence the ability of ecosystems to maintain their role as carbon sinks.

Looking at trends in carbon sequestration, a Forest Service study conducted an assessment of carbon sequestration capabilities of the national forests in California over the next 100 years (USFS 2009). The assessment analyzed forest growth, disturbance, and management options under a range of management scenarios for the national forests in California. The analysis concluded that under then current (2009) forest management activities, over the next four to six decades, California's national forests will accumulate carbon at a higher rate than carbon will be lost. This will be at a decreasing rate because of increased carbon loss through disturbances such as wildfire, insect and disease related pest mortality and inter-tree competition. However, at some point in the mid-21st century, carbon losses from wildfire, disease and other disturbances will exceed sequestration, and national forests in California will become net emitters of carbon.

For more detailed information on condition and trend in the bio-region see the snapshot of the Bio-Regional Living Assessment Chapter 4, lines 122-479.

Contributions the Plan Area Makes to Ecological, Social or Economic Sustainability

The forests of the bio-region will play an important role in helping California meet its greenhouse gas emission reduction goals. Currently, these forests store a large quantity of carbon in living biomass, standing and downed woody debris, litter and soil organic carbon. Markets for carbon do exist and therefore a price for carbon has been established and can be used to value this sequestration. A central element of California's Global Warming Solutions Act (AB 32) is a cap and trade program now underway, which allows the state to distribute carbon allowances as tradable permits (CARB 2013).

Forest management can affect the value of carbon sequestration by controlling stand structure, composition and growth rates, as well as by influencing the frequency, size and severity of natural disturbances that would reduce current inventories. A recent study determined that this value to people of carbon sequestration is largely dependent the frequency and extent of wildfires in the bio-region. As a result, without an increase in the pace and scale of ecological restoration, it was estimated that the forests of the bio-region will become net emitters of carbon sometime around the middle of the 21st century. Therefore, increased pace and scale of restoration to reduce fire disturbances will be critical in maintaining the long term value of carbon sequestration (USDA Forest Service 2009).

In addition, restoration can contribute to economic and social wellbeing by providing opportunities for wood product activities. According to the Intergovernmental Panel on Climate Change (IPCC) "When used to displace fossil fuels, wood fuels can provide sustained carbon benefits, and constitute a large mitigation option" (Nabuurs et al. 2007 p.551). A recent study estimates that forests in the United States are capable of sustainably producing 368 million dry tons of wood per year, with 41 million dry tons from currently unused logging residues and 60 million dry tons from hazardous fuel treatments (Perlack et al. 2005). If applied to bioenergy production, this wood residue could offset a substantial percentage of the country's CO_2 emissions from fossil fuels (Richter et al. 2009).

In addition to ongoing energy production from milling byproducts at area wood processing facilities, several opportunities exist to use wood residues from timber harvest, hazardous fuel reduction projects, and other silvicultural treatments in the assessment area. These opportunities include an extensive network of bioenergy facilities, potential to develop a network of small bioenergy systems under California Senate Bill 1122, as well as a strong push by the biomass industry to develop strategically located wood heating systems to offset propane, diesel and electric systems. There is potential for a substantial increase in wood energy production in the assessment area that could replace CO_2 emissions from fossil fuels, while also reducing CO_2 emissions from pile burning and other forest residue treatments.

For more detailed information on carbon and its contribution to sustainability in the bio-region see the snapshot of the Bio-Regional Living Assessment Chapter 4 lines 480-526.

Information Gaps

Information gaps are not prohibiting us from discussing condition and trend at this time.

Chapter 5: At-Risk Species

At-risk species are defined as 1) the federally recognized threatened, endangered, proposed, and candidate species; and 2) species of conservation concern known to occur within the plan area. The list of at-risk species is identified by the Regional Forester in coordination with the Sequoia National Forest Supervisor. Species of Conservation Concern are identified using the NatureServe ranking system to highlight species that have a substantial concern about their capability to persist over the long term in the plan area, considering local information and local conditions. A detailed process to identify the potential species of conservation concern is provided in the proposed Forest Service Handbook directives (USDA USFS 2013, proposed FSH 1909.12 Section 12.5). For the assessment, the list of species of conservation concern is purposefully called a "potential" list, because it can be refined to add or remove species through the plan revision process.

The purpose of identifying at-risk species is to help develop forest plans that maintain the diversity of plant and animal communities and provide for the persistence of native species in the plan area (36 CFR 219.9). Most species will be maintained by plan components (desired conditions, objectives, standards, guidelines, and suitability of lands) that provide for broad ecosystem integrity and ecosystem diversity. Some species may require additional species-specific plan components, particularly to help in recovering federally recognized species or where the species requires unique and specific ecological conditions that are best addressed with more focused plan components. Additionally, the 2012 Planning Rule recognizes that it may not be possible to maintain a viable population of some at-risk species within the plan area due to circumstances beyond the authority of the Forest Service or due to limitations in the inherent capability of the land. Examples might be migratory species where viability is primarily affected in other locations, temperature sensitive species affected by warming temperatures, or where the plan area has limited ecological capacity to provide sufficient habitat to sustain the species.

Important Information Evaluated in This Phase

The Giant Sequoia National Monument and Sequoia National Forest Travel Management Biological Evaluations and Biological Assessments were used to generate the listed species description for wildlife and plants. Fisher, fish and amphibian descriptions were taken from the Sequoia National Forest Living Assessment Chapter 1. In addition, species account information for some federally listed species was provided by the April 8, 2013 snapshot of the Bio-Regional Living Assessment Chapter 5. Risk factors, and trends related to habitats and ecological conditions were derived from Chapters 1, 2 and 3 of this assessment. Conditions and trends for human-related stressors such as habitat fragmentation from encroachment and development, and disturbance from recreation and other uses of the forest are described in more detail in Chapters 6, 7, and 9 of this assessment. This summary information is not intended to be complete regarding a species life history, but is an overview to highlight key ecological conditions and status and trends for each species. The full suite of readily available information relevant to at-risk species will be considered when developing and evaluating plan components throughout plan revision.

Nature, Extent and Role of Existing Conditions and Future Trends

Federally recognized species under the Endangered Species Act (ESA) and species of conservation concern are two distinct components of at-risk species. They each play a role in informing the development of plan components. National forests are managed to contribute to the recovery of federally listed species and to not jeopardize listed species or their habitats. Plan components are developed to provide the ecological conditions necessary to maintain a viable population of species of conservation concern within the plan area. This assessment will briefly describe three key factors for each federally listed species:

- species status on the Sequoia National Forest
- key ecological conditions needed to support the species
- key risk factors that affect the species

Federally Recognized Species

On the Sequoia National Forest, there are ten species federally recognized as threatened, endangered, proposed, and candidate species. They are separated into the following life form groups: fish; amphibians and reptiles; birds and mammals; invertebrates; and plants.

Fish, Amphibians and Reptiles

Federally recognized fish, amphibians and reptiles

Common Name	Scientific Name	Status
Little Kern golden trout	*Oncorhynchus mykiss aquabonita*	Threatened
Mountain yellow-legged frog	*Rana muscosa*	Candidate

Little Kern golden trout

Species Status on the Sequoia National Forest

The Little Kern golden trout is found only throughout the Little Kern River basin, mostly within the Golden Trout Wilderness. Critical habitat was designated within the Little Kern River watershed and the majority is on the Sequoia National Forest. As a result of stocking of non-native rainbow and brook trout, today only about ten miles of streams in the Little Kern River system contain genetically pure Little Kern golden trout. Surveys are underway in summer 2013 to document the current status of this iconic trout.

Key Ecological Conditions Needed to Support the Species

Habitat. Little Kern golden trout prefer cold, deep, narrow channels in meadows and streams with adequate pools, riparian vegetation, in-stream cover from boulders and cobble and gravels for spawning.

Isolation. Little Kern golden trout do not compete well with other trout species and rarely co-exist when non-native trout are introduced. The distribution of the native Kern River rainbow in the main stem Kern River would have limited the Little Kern golden trout to the Little Kern River.

Cold water. During spawning and egg incubation, water temperatures below 55 degrees Fahrenheit are required. Non-breeding adults can withstand greater fluctuations in temperature, and do best in water temperatures less than 68 to 72 degrees Fahrenheit.

Key Risk Factors

Non-native trout. The illegal movement of rainbow trout or brook trout could diminish the genetic integrity of pure genetic stocks and lower population number.

Climate change. Warming temperatures, changes in timing of snowmelt, and intensity of floods are a concern because of the trout's vulnerability to increased stream temperatures and changes in flows.

Fire. Sedimentation of spawning gravels and sedimentation as a result of increased risk of fire in the basin is a concern.

For more information see the August 2, 2013 snapshot of the Sequoia National Forest Living Assessment Chapter 1, lines 709-796.

Mountain yellow-legged frog

Species Status on the Sequoia National Forest

By the mid-1990s, frogs on the Sequoia National Forest were in need of protection. The northern most population of the Mountain yellow-legged frog is a candidate for federal listing; and proposed critical habitat is distributed at very high elevation lakes on the Sequoia National Forest. All remaining occupied locations on the forest are at high elevation. The frogs were extirpated from meadow and stream habitats between 5,000 and 6,000 feet.

Key Ecological Conditions Needed to Support the Species

Deep water in high elevation lakes and streams. Suitable habitat conditions for this species depend on sufficient perennial water to meet the needs of each life stage. Adjacent streambank and lakeshores provide a range of habitats. At lower elevations the frogs occurred in naturally fishless streams. At higher elevations, deeper fishless lakes provide a range of habitat.

Key Risk Factors

Non-native fish. Trout introduced into lakes and naturally fishless streams are cited as a primary factor causing loss of habitat for this species. They also cause fragmentation of habitat.

Disease. Chytrid fungus causes mutations and other issues with frogs, preventing them from eating or developing properly.

Climate change. This species requires deep perennial water that serves as breeding habitat and overwintering protection from lake freezing. Changes in snowpack and season and timing of rain and snow can affect summer water temperatures and depth, as well as winter lake freezing.

Fragmentation of populations. The majority of populations are small and isolated, increasing the risk that the loss of populations will create barriers to genetic mixing and other genetic risks inherent to small populations.

For more information see the August 2, 2013 snapshot of the Sequoia National Forest Living Assessment Chapter 1.

Birds and Mammals

Federally recognized birds and mammals

Common Name	Scientific Name	Status
Southwestern willow flycatcher	*Empidonax traillii extimus*	Endangered
Least Bell's vireo	*Vireo bellii pusillus*	Endangered
California condor	*Gymnogyps californianus*	Endangered
Western yellow-billed cuckoo	*Coccyzus americanus occidentalis*	Candidate
Fisher	*Martes pennant*	Candidate

Southwestern willow flycatcher

Species Status on the Sequoia National Forest

On the Sequoia National Forest, the species is currently found in the South Fork Kern River with a population nesting in the South Fork Kern River Valley. The Southwestern willow flycatcher typically arrives in the South Fork of the Kern River Valley in May of each year. The breeding season runs between May and late August, until the birds leave their summer grounds for southern destinations in early September.

Key Ecological Conditions Needed to Support the Species

Dense vegetation riparian habitats: Nesting occurs in dense riparian habitats, especially dense willow thickets in broad, open river valleys or large mountain meadows (Zeiner et al 1990).

Key Risk Factors

Cowbird parasitism. Nest parasitism by brown-headed cowbirds has been well documented as a threat (USDI-FWS 1993, Sogge et al. 1997).

Livestock grazing. Livestock can impact willows reducing habitat quality as well as directly disturbing nests in willows. Livestock can impact other aspects of meadows important to successful willow flycatcher breeding, such as conditions that support abundant insect prey.

Disturbance and Noise: This species may be sensitive to noise and disturbance from recreation and other human activities. There may be lowered reproductive success when nest sites are exposed to higher noise levels.

Least Bell's vireo

Species Status on the Sequoia National Forest

The historical range of the Least Bell's vireo included valley and lowland and foothill areas with willows (Grinnel 1986). The species is currently known to occur in the South Fork Kern River. Surveys have been conducted since 1997 and only one observation occurred in 2002. However, from 1992 to 1997, at least eight other individuals were reported moving through the Kern River Valley (Douglas 2008). Surveys in 2011 also documented a male within the South Fork Wildlife Area of the Sequoia National Forest. Surveys in 2012 had no detections of Least Bell's vireo.

Key Ecological Conditions Needed to Support the Species

Structurally complex riparian habitat: Habitats are complex, typically associated with willow, cottonwood, mulefat, wild blackberry, or mesquite (Zeiner et al. 1990).

Key Risk Factors

Cowbird parasitism: Nest parasitism by brown-headed cowbirds has been well documented as a threat (Garrett and Dunn 1981).

California condor

Species Status on the Sequoia National Forest

The species historically occurred more widely throughout the southwest and also fed on beaches and large rivers along the Pacific coast. During recent years, condors have been documented flying over and roosting on the Sequoia National Forest, as far north as the Hume Lake Ranger District in southern Fresno County. However, there are no reports of feeding or nesting on the forest (USDI-USFWS 2012a).

Key Ecological Conditions Needed to Support the Species

Contributions to large animal prey. The forest is likely providing sources of potential prey. Natural mortality of ungulates and other large animals serve as potential sources of prey for foraging condors.

Key Risk Factors

Lead ingestion and shooting. As carrion feeders, condors are highly susceptible to lead poisoning from eating lead bullets or fragments in dead animals. Artificial feeding and careful monitoring for signs of lead poisoning are currently used in response to this risk. In addition, condors continue to be targets for illegal shooting (USDI-USFWS 2013a).

Collision with power lines. Since 1992, four condors are known to have died related to collision with powerlines, however none occurred on the Sequoia National Forest (USDI-USFWS 2012a).

Western yellow-billed cuckoo

Species Status on the Sequoia National Forest

The historical range of the western yellow-billed cuckoo includes the Central Valley and foothills, including the South Fork Kern River. The species is currently found on the South Fork Kern River from Isabella Reservoir to Canebrake Ecological Reserve (Laymon 1998).

Key Ecological Conditions Needed to Support the Species

Large blocks of riparian habitat. Home ranges in the South Fork Kern River are large, averaging 42 acres (Laymon et al. 1993). These large blocks provide dense understory foliage and high humidity, which may be an important factor (Rosenburg et al. 1991).

Key Risk Factors

Loss or degradation of riparian habitat. Activities which contribute to the degradation of key riparian habitat in the South Fork Kern River could reduce breeding potential.

Climate change. The western yellow-billed cuckoo may be sensitive to warming and drying conditions that would result in loss of the mesic nesting habitats with higher humidity that may be linked to nesting success (Hamilton and Hamilton 1965, Rosenburg et al. 1991).

Fisher

Species Status on the Sequoia National Forest

Zielinski et al. (1995) determined that fishers remain in just two areas comprising less than half of the estimated historic distribution: northwestern California and the southern Sierra Nevada from Yosemite National Park south, separated by a distance of about 250 miles.

Recent estimates of fisher in the southern Sierra Nevada indicate there are approximately 160–360 adults (Spencer et al. 2008). There are indications that the southern Sierra Nevada population is stable (Zielinski et al. 2013, Sweitzer 2013). Status and trend monitoring for fisher initiated in 2002 indicates that fishers are well-distributed in portions of the southern Sierra national forests, with annual occupancy rates consistently higher on the Sequoia National Forest than the Sierra National Forest.

Key Ecological Conditions Needed to Support the Species

Forest overstory and understory cover. Fisher tends to avoid large open areas (Weir and Corbould 2010) and maintaining diverse understory vegetation is thought to be important to support abundant diverse prey (Naney et al. 2012). Recent research highlights the importance of fine scale and landscape scale heterogeneity and the role that understory cover plays in fisher use of den sites across their home range.

Hardwood trees for cavities and acorn mast. Large, mature hardwoods provide cavities for resting and denning, and also support abundant prey species. Areas with large hardwoods and abundant mast support smaller home ranges as animals can find sufficient food resources in a smaller area (MacFarlane 2010, Zielinski et al. 2004).

Key Risk Factors

Loss of key forest structures, forest canopy, and fragmentation. Large areas of high severity fire can reduce important forest structures such as large trees with cavities and mature mast-producing hardwoods. Fisher require areas with sufficient overstory and understory cover and uncharacteristically severe wildfire can reduce tree cover, fragment these areas and create barriers to animals traveling across heavily burned areas. These same key habitat elements can be affected by planned management activities.

Rodenticide poisoning. Recent studies have documented a significant threat to fisher from rodenticide poisons commonly used in illegal marijuana plantations (Gabriel 2012, 2012b).

Road related mortality. Fisher has been killed along primary roads by passing vehicles.

Invertebrates

Federally recognized invertebrates

Common Name	Scientific Name	Status
Valley elderberry longhorn beetle	*Desmocerus californicus dimorphus*	Threatened

Valley elderberry longhorn beetle

Species Status on the Sequoia National Forest

The range of this species in California consists of patchy distribution from Redding south to Bakersfield, and the western Sierra Nevada foothills to eastern coastal range foothills up to 3,000 feet in elevation. Habitat consists of elderberry shrubs and trees in a variety of habitats and plant communities in the Sierra foothills below 3,000 feet in elevation. Most often, habitat is found in riparian, elderberry savannah or moist valley oak woodlands. This species is most often found along the margins of rivers and streams in the lower Sacramento River and upper San Joaquin Valley. It was more abundant in dense native plant communities with a mature overstory and a mixed understory (Barr 1991). Plants may be associated with riparian zones or moist areas, primarily on north facing slopes scattered throughout the chaparral.

This species is currently under review for delisting due to the increased number of known populations and existing habitat protections in place (USDI-USFWS 2006, USDI-USFWS 2012b). Habitat for this beetle exists in the lowest elevations of the Kern River on the Sequoia National Forest. No confirmed reports of these beetles have been reported on the forest, although potential habitat exists near Lake Isabella.

Key Ecological Conditions Needed to Support the Species

Elderberry shrubs and trees. The presence of elderberry is important to this species. Potentially suitable elderberry can occur in a variety of habitats.

Key Risk Factors

Loss or disturbance of elderberry. Fire can damage or kill occupied elderberry. The risk of project-related effects are low because activities that may potentially affect elderberry plants are evaluated and designed to avoid elderberry plants or mitigate impacts by planting replacement elderberry plants for those affected.

Plants

Federally recognized plants

Common Name	Scientific Name	Status
Springville Clarkia	*Clarkia springvillensis*	Threatened
Bakersfield Cactus	*Opuntia basilaris var. trelease*	Endangered

Springville Clarkia

Species Status on the Sequoia National Forest

Springville Clarkia grows in openings within the chaparral and foothill woodland plant communities and the transition zones between them. This flower is found only in the foothills of the Sierra Nevada in a small area of Tulare County, California. There are about 12 occurrences on the Sequoia National Forest.

Key Ecological Conditions Needed to Support the Species

Soils. The soils that support Springville Clarkia are loams or sandy loams derived from decomposed granite.

Slope and Aspect. The most favorable sites for this species appear to be steep slopes that face south or west.

Shade: Afternoon shade from shrubs or trees seems to be present where these populations persist.

Fire. Recent burned areas appear to provide favorable habitat

Key Risk Factors

Development. Ground disturbance for construction of buildings, palettes for homes, or roads can eliminate occurrences of the species.

Roads. Road maintenance activities such as grading and roadside mowing, and spraying of nearby weeds

Grazing. Heavy, repeated, and/or late season grazing by livestock and trampling are threats to this species. However, properly management for timing and length of stay in an area has reduced this threat.

Fire Suppression. Fires used to reduce competition from both nonnative herbs and native tree and shrub species.

Bakersfield cactus

Species Status on the Sequoia National Forest

Bakersfield cactus is found in a limited area of in the Sequoia National Forest and the vicinity of Bakersfield. Approximately one-third of the historical occurrences of Bakersfield cactus have been eliminated, and the remaining populations are highly fragmented. However, the range was extended to the south when several occurrences were discovered in the late 1980s in south-central Kern County, just north of Wheeler Ridge. The one occurrence on Sequoia National Forest lands is protected at this time, but most known populations of Bakersfield cactus are not formally protected.

Key Ecological Conditions Needed to Support the Species

Soils. Soils supporting Bakersfield cactus typically are sandy, although gravel, cobbles, or boulders also may be present.

Habitat specificity. Known populations occur on flood plains, ridges, bluffs, and rolling hills. The Bakersfield cactus is a characteristic species of the Sierra-Tehachapi Saltbush Scrub plant community, but populations near Caliente are in Blue Oak Woodland and the Cottonwood Creek population is in riparian woodland.

Key Risk Factors

Development. Ground disturbance for farming, construction of commercial buildings or homes, or roads can eliminate occurrences of the species.

Off road vehicles. Off road vehicles continue to degrade the populations mentioned earlier.

Exotic grasses. Annual grasses are believed to threaten the survival of mature Bakersfield cactus plants and to hinder the establishment of new plants. Indirect effects from exotic grasses may threaten

Bakersfield cactus. The dense herbaceous growth may promote a greater fire frequency and intensity than would have occurred with the sparse native vegetation typical in historical times.

Fire. The effect of repeated fires has not been determined. However, survival of Bakersfield cactus plants was monitored following single fire events at Sand Ridge and near the Rio Bravo Hydroelectric Plant in Kern Canyon. All Bakersfield cactus clumps survived the fires at both sites, despite browning and wilting of the pads.

Lack of Genetic Diversity. Contributing factors include the small size of many populations and lack of gene flow between populations.

Potential Species of Conservation Concern

Species of Conservation Concern are species known to occur on the Sequoia National Forest that the Regional Forester of the Pacific Southwest Region of the Forest Service determines best available scientific information shows a substantial concern about their capability to persist over the long term in the plan area.

The 2012 Planning Rule draft directives describe the process to identify species of conservation concern. A potential list is identified here based on evaluating the species status rankings from the NatureServe ranking system and other criteria that could indicate a substantial concern as defined in the draft directives. This list will be modified, based on the best available scientific information and public input during the planning process before approval of the forest plan.

Fish, Amphibians and Reptiles

Potential Species of Conservation Concern - fish, amphibians and reptiles

Common Name	Key Ecological Conditions	Key Risk Factors
California golden trout *Oncorhynchus mykiss aquabonita*	Spawning gravel riffles Cold water	Hybridization with non-native rainbow trout Climate change-warming of water Fire in highly restricted remnant population
Kern River rainbow trout *Oncorhynchus mykiss gilberti*	Currently restricted to high elevation portions of the Kern River, former range was Kern River down to Lake Isabella	Hybridization with non-native rainbow trout Climate change –warming of water Fire in highly restricted remnant population
Kern Brook Lamprey *Lampetra hubbsi*	Cool water, large rivers Gravel-rubble substrate	Water quality Habitat fragmentation- dams Water quantity
Hardhead Minnow *Mylopharodon conocephalus*	Warm, slow water Clear water	Water quantity Habitat fragmentation-dams
Foothill Yellow-legged Frog	Partially shaded rocky streams	Water quality Nonnative fish in previously

Common Name	Key Ecological Conditions	Key Risk Factors
Rana boylii		fishless areas. Water quantity
Yellow-blotched salamander *Ensatina eschscholtzii croceater*	Woodlands and riparian areas Down logs and litter	Ground disturbance Fire
Kings River slender salamander *Batrachoseps regius*	Logs or rocks with tree overstory Talus slopes	Ground disturbance Roads- habitat fragmentation Fire
Relictual slender salamander *Batrachoseps relictus*	Seeps Streams	Roads- habitat fragmentation Fire Ground disturbance
Kern Canyon slender salamander *Batrachoseps simatus*	Rocks and logs Talus slopes	Roads. habitat fragmentation Fire Ground disturbance
Fairview slender salamander *Batrachoseps bramei*	Talus slopes	Roads Fire
Western pond turtle *Actinemys marmorata*	Aquatic habitats Shorelines	Water quality Water quantity Shoreline disturbance
California legless lizard *Anniella pulchra*	Loose soils Surface vegetation litter	Ground disturbance Fire

Summary of Key Ecological Conditions and Key Risk Factors for Fish, Amphibians, and Reptiles

The key ecological conditions and key risk factors for these potential species of conservation concern can generally be characterized as either aquatic or terrestrial focused. For aquatic species (Kern River rainbow trout, hardhead minnow, Kern Brook lamprey, foothill yellow-legged frog, and western pond turtle) the key risk factors are climate change, invasive species, fire and habitat fragmentation or lack of connectivity. Severe wildfire and trends in climate change generally have a negative influence on water quantity and quality and can change the distribution of habitat and can change where suitable habitats exist. Large changes in habitat can occur due to large areas burned by moderate or high severity fire, or by warming and drying conditions associated with climate change. Changes can also occur at the local scale (e.g. streambank impacts from livestock, recreation activities, roads, or trails), which can be important for these species with limited populations or limited habitat. For the more terrestrial salamander species, ground-based disturbance from a variety of sources could directly impact individuals on the surface or under rocks, logs or forest litter. They can also be negatively affected by fire, but their habitat may be maintained or improved with the restoration of periodic fire. As these species tend to be fairly localized, trends can only be evaluated in the context of known habitats and suitable habitat or specific habitat areas.

Birds and Mammals

Potential Species of Conservation Concern - birds and mammals

Common Name	Key Ecological Conditions	Key Risk Factors
Sierra Marten *Martes americana sierrae*	Mature conifer forests Abundant snags and down logs Heterogeneous habitat for cover and prey species.	Habitat loss Habitat fragmentation (large wildfires) Roads (mortality and predator access)
Fringed Myotis *Myotis thysanodes*	Hibernation sites (mines and buildings) Roost sites (caves, mines, buildings, crevices, snags)	Hibernation disturbance Loss of snags Roost disturbance
Townsend’s Big-eared bat *Corynorhinus townsendii*	Caves and mines	Roost disturbance (recreation and mining) Pesticides
Pallid Bat *Antrozous pallidus*	Mountainous areas and near water 3 different roost sites open areas for foraging	Roost disturbance (recreation) Pesticides Loss of roost trees and snags
Northern Goshawk *Accipiter gentilis*	Diverse forest habitats for prey Structurally diverse forests for nesting Snags (for prey habitat)	Fire (loss of nesting habitat) Habitat loss (timber harvest, fire, drought related tree mortality)
“Little” Willow Flycatcher *Empidonax traillii brewsteri*	Wet meadows with woody riparian shrubs Standing water in meadows	Meadow drying (roads, historic impacts, water diversions) Nest disturbance (predators and nest parasitism) Livestock grazing
Bald Eagle *Haliaeetus leucocephalus*	Large, old, multi-storied stands for nesting	Disturbance (recreation – summer and winter) Fire (loss of nest and roost trees)
Great Gray Owl *Strix nebulosa*	Meadows and meadow complexes Adequate grass heights for prey Nest trees near meadows	Livestock grazing Fire (exclusion in meadows and loss of nest and roost trees) Disturbance (recreation and livestock) Loss of snags Mortality (Vehicle collisions, West Nile Virus)
California Spotted Owl *Strix occidentalis occidentalis*	Structurally diverse older forests Snags Habitat for prey (flying squirrel and woodrat)	Habitat loss (timber harvest, fire, drought related tree mortality) Habitat fragmentation Fire (loss of nest trees and exclusion reducing habitat for prey) Mortality (Barred owl, West Nile Virus)

Common Name	Key Ecological Conditions	Key Risk Factors
American Peregrine Falcon *Falco peregrinus anatum*	Cliffs	Disturbance (rock climbing)
Black-backed Woodpecker *Picoides arcticus*	Abundant snags with abundant insect prey Conifer forest with dense medium and large trees burned at moderate to high severity	Post-fire timber harvest Habitat distribution (burned areas creating suitable habitat across space and time – habitat is highly used for less than 10 years after burned)
Mount Pinos Sooty Grouse *Dendragapus fliginosus howardi*	Red fir dominated forests Meadows	Livestock grazing Fire (exclusion) Disturbance (recreation, project activity) Climate change
Tri-colored Blackbird *Agelaius tricolor*	Riparian habitat	Loss of native habitat Pesticides

Summary of Key Ecological Conditions and Key Risk Factors for Birds and Mammals

The key ecological conditions for these species and the key risk factors affecting those conditions can be generally described as:

- Cliffs, caves, buildings and mines (fringed myotis, Townsend's big-eared bat, Pallid bat and American peregrine falcon)
    - Risk of recreation-related disturbance to bats
- Meadows and riparian habitat (willow flycatcher, great gray owl, Mt. Pinos sooty grouse, and tri-colored blackbird)
    - Risk of direct browsing and damage to riparian vegetation and maintenance of meadow conditions. Livestock grazing can affect the key ecological conditions of meadows and riparian areas by changing vegetation height over the summer and by affecting riparian willows and alders.
    - Risk of altered forest edge habitat adjacent to and in meadows from fire suppression and uncharacteristic wildfire. .Snags and forest cover are important components for great gray owl.
- Structurally diverse mature forests (American marten, northern goshawk, California spotted owl and black-backed woodpecker)
    - Risk of loss of habitat and habitat fragmentation of conifer forest from wildfire outside the natural range of variability. While the current trends do not show a significant increase in the extent of forest change from wildfire on the Sequoia National Forest substantial areas are at a low and very low fire resiliency index as described in Chapter 3 of this assessment, indicating they are susceptible to higher amounts of crown fire than expected.

- Large trees and snags (bald eagle and California spotted owl)
    - Risk of inadequate number, distribution, and quality of large living trees and dead trees (snags) of sufficient density, size, area and age to support key life history needs of species. Due to fire suppression, there may be fewer total patches of snags created from fire across the landscape. However, some fire-created patches of snags are exceedingly large and are created from burning older forests which competes with the habitat need for other at-risk species that need large living trees such as the California spotted owl and fisher.

Additionally some risk factors are not directly associated with a key ecological condition. These include:

- Recreation and activity related disturbance (bald eagle and great gray owl). These species are often sought out by recreationists for wildlife viewing but they can be easily disturbed during breeding causing nest failure. They may also be disturbed by management activities.
- Primary roads are a source of direct mortality to some species such as great gray owl and marten.

Invertebrates

Potential Species of Conservation Concern - invertebrates

Common Name	Key Ecological Conditions	Key Risk Factors
Tehachapi fritillary butterfly *Speyeria egleis tehachapina*	Host plants on mountain summits and peaks	Fire (effects on host plants, short and long term) Climate change

Summary of Key Ecological Conditions and Key Risk Factors for Invertebrates

Key ecological conditions and risk factors for the invertebrate potential species of conservation concern are still being synthesized at the time of this writing. This information will be available in the final assessment. The Sequoia National Forest does not have comprehensive butterfly or aquatic invertebrate data to assess potential rare species presence or absence across the forest.

Plants

This list is still very preliminary. This initial list comes primarily from information and analysis for the Giant Sequoia National Monument Management Plan. The forest botanist is reviewing additional information to validate and refine this list and it will be completed and included in the final assessment.

Potential Species of Conservation Concern – plants

Common Name	Key Ecological Conditions	Key Risk Factors
Sharsmith's Stickseed *Hackelia sharsmithii*	To be determined (TBD)	TBD
Piute Buckwheat	TBD	TBD

Common Name	Key Ecological Conditions	Key Risk Factors
Eriogonum breedlovei var. breedlovei		
Kings River Buckwheat *Eriogonum nudum* var. regirivum	TBD	TBD
Twisselmann's Buckwheat *Eriogonum twisselmannii*	TBD	TBD
Olancha Peak Buckwheat *Eriogonum wrightii* var. olanchense	TBD	TBD
Needle's Buckwheat *Eriogonum breedlovei* var. shevockii	TBD	TBD
Mouse Buckwheat *Eriogonum nudum* var. murinum	TBD	TBD
Monarch Buckwheat *Eriogonum ovalifolium* var. monarchense	TBD	TBD
Unexpected Larkspur *Delphinium inopinum*	TBD	TBD
Kern County Larkspur *Delphinium purpusii*	TBD	TBD
Bakersfield Beavertail Cactus *Opuntia basilaris* var. treleasei	TBD	TBD
Purple Mountain-parsley *Oreonana purpurascens*	TBD	TBD
Spiny Sepaled Coyote-thistle *Eryngium spinosepalum*	TBD	TBD
Aromatic Canyon Gooseberry *Ribes menziesii* var. ixoderme	TBD	TBD
Sequoia Gooseberry *Ribes tularense*	TBD	TBD
Gunsight Clarkia *Clarkia xantiana* ssp. parviflora	TBD	TBD
Temblor Range Clarkia *Clarkia tembloriensis*	TBD	TBD
Purple Birds-beak *Cordylanthus eremicus ssp. kernensis*	TBD	TBD
Slenderstalk Monkeyflower *Mimulus gracilipes*	TBD	TBD
Kelso Creek Monkeyflower *Mimulus shevockii*	TBD	TBD

Common Name	Key Ecological Conditions	Key Risk Factors
Kaweah Monkeyflower *Mimulus norrisii*	TBD	TBD
Calico Monkeyflower *Mimulus pictus*	TBD	TBD
Ramshaw Meadows Abronia *Abronia alpina*	TBD	TBD
Largeleaf Filaree *Erodium macrophyllum*	TBD	TBD
Bolander's Woodreed *Cinna bolanderi*	TBD	TBD
Prairie Wedgegrass *Sphenopholis obtusata*	TBD	TBD
Munz's Iris *Iris munzii*	TBD	TBD
Kaweah Brodiaea *Brodiaea insignis*	TBD	TBD
Palmer's Mariposa Lily *Calochortus palmeri* var. palmeri	TBD	TBD
Alkali Mariposa-lily *Calochortus striatus*	TBD	TBD
Shirley Meadows Star-tulip *Calochortus westonii*	TBD	TBD
Kaweah Lakes Fawnlily *Erythronium pusaterii*	TBD	TBD
Striped Adobe Lily *Fritillaria striata*	TBD	TBD
Greenhorn Fritillary *Fritillaria brandegeei*	TBD	TBD
Onyx Bedstraw *Galium angustifolium* ssp. onycense	TBD	TBD
Keck's Checker-mallow *Sidalcea keckii*	TBD	TBD
Parry's Mallow *Eremalche parryi*	TBD	TBD
Sweet-smelling Monardella *Monardella beneolens*	TBD	TBD
Flax-like Monardella *Monardella linoides* ssp. Oblonga	TBD	TBD
Bodie Hills Rockcress *Arabis bodiensis*	TBD	TBD
Shockley's Rockcress *Arabis shockleyi*	TBD	TBD
Jaeger's Caulostramina	TBD	TBD

Common Name	Key Ecological Conditions	Key Risk Factors
Caulostramina jaegeri		
Lake Tahoe Draba *Draba asterophora* var. asterophora	TBD	TBD
Mt. Whitney Draba *Draba sharsmithii*	TBD	TBD
Piute Mountains Jewelflower *Streptanthus cordatus* var. piutensis	TBD	TBD
Tehipite Valley Jewelflower *Streptanthus fenestratus*	TBD	TBD
Alpine Jewelflower *Streptanthus gracilis*	TBD	TBD
Masonic Mountain Jewelflower *Streptanthus oliganthus*	TBD	TBD
Unequal Rockcress *Arabis dispar*	TBD	TBD
Darwin Rock Cress *Arabis pulchra* var. munciensis	TBD	TBD
Hoary Draba *Draba cana*	TBD	TBD
Mineral King Draba *Draba cruciata*	TBD	TBD
Entireleaf Thelypody *Thelypodium integrifolium* ssp. complanatum	TBD	TBD
Jared's Pepper-grass *Lepidium jaredii*	TBD	TBD
California Jewelflower *Stanfordia californica*	TBD	TBD
Tulare Cryptantha *Cryptantha incana*	TBD	TBD

Summary of Key Ecological Conditions and Key Risk Factors for Plants

The key ecological conditions and risk factors for the plant potential species of conservation concern are still being synthesized at the time of this writing. This information will be available in the final assessment. All are known to occur on the Sequoia National Forest based on records in the California Natural Diversity Database (CNDDB 2013) and Sequoia National Forest field survey and GIS data.

Overall Summary of Key Ecological Conditions and Key Risk Factors

Climate change is a key risk factor that applies either directly or indirectly to all at-risk species. A summary of current conditions and trends related to climate change is provided in Chapter 3 of this assessment. These species are identified as at-risk due to low population size, low amounts of suitable habitat, or substantial threats to populations or habitats. The projected changes in both habitats and ecological processes that may result from climate change could have a disproportionate impact on at-risk species as they may be less able to respond to changed conditions or be robust enough to recover from abrupt climate-related changes. For example, small localized populations or limited habitat could be effectively eliminated by a single large wildfire event with little opportunity for re-colonization from adjacent areas over time as habitats recover.

For aquatic species, changes in types and patterns of precipitation, particularly rain and snowfall patterns, could alter key life cycle sequences. For example, the mountain yellow-legged frog is strongly tied to deep water in high elevation lakes for breeding during a short breeding season. If patterns of snowfall change or lake freeze and thaw patterns change, the timing of winter hibernation will change. This could expose frogs to predators for longer periods. Climate change could alter any of these important conditions, resulting in lowered breeding success or increased mortality. As each species has a unique set of environmental relationships, this assessment defers to the more detailed species accounts when detailed life history and threat information is needed to support developing and evaluating potential plan components.

Fire is another key risk factor that applies to many at-risk species and current conditions and trends are described in Chapter 3 of this assessment. Habitats for at-risk species in the large area of the Sequoia National Forest at low to mid-elevations where fires have burned less frequently than historically that also have low or very low wildland fire resilience have a higher potential to be negatively affected by future large wildfires. See Chapter 3 of this assessment for more detail on this subject. The implications of this habitat change from wildfires depends on 1) the specific habitat types used or required by each species; 2) the amount and extent of remaining suitable habitat in burned areas; and 3) how quickly suitable habitat and other necessary conditions recover. Wildfires that burn large areas of structurally diverse older forests at moderate and high severity generally reduce high quality breeding habitat for species such as California spotted owl, northern goshawk, and marten over the long term, but would increase high quality nesting and foraging habitat for species that use complex early seral forests in the short term, such as the black-backed woodpecker.

Livestock grazing is a key risk factor for many aquatic species, several plant species and a few vertebrate species, especially those associated with meadows and riparian areas. Current livestock numbers on the Sequoia National Forest are approximately 60 percent of those permitted in the 1960s. Conditions in meadows and riparian areas have generally been improving and most measures of rangeland condition indicate an upward trend. See this assessment, Chapter 1-Riparian Ecosystems and Chapter 8-Multiple Uses-Range for additional information about meadow and riparian conditions and trends. Regardless of these general conditions and trends, conditions and trends for each species should be evaluated in the context that several at-risk species have limited ranges or specific habitat requirements and low population numbers. This level of detail is not readily available for consideration in this assessment, but will be considered, as appropriate, during later plan revision phases.

Contributions the Plan Area Makes to Ecological, Social or Economic Sustainability

The presence of at-risk species in the plan area affects management decisions. For federally listed species, projects are generally designed to maintain or enhance habitat and to avoid or mitigate potential effects to individuals in order to comply with the Endangered Species Act. This can increase the time and cost for project planning if species inventory is needed, or if additional work is needed to assess habitat conditions before making a project decision. In addition, procedures to ensure appropriate regulatory oversight, provided by the U.S. Fish and Wildlife Service and NOAA Fisheries, are factored into project level planning when federally listed species could be affected. This can impact the rate and pace for designing and implementing projects aimed at ecological restoration.

However, specific funding exists for projects designed to enhance at-risk species habitats or reduce threats to at-risk species, and often projects with an objective to benefit at-risk species are given a priority for funding or emphasis. Partnerships with other agencies and stakeholder groups are often focused on benefitting at-risk species. This can increase support for projects aimed at ecological restoration that reduce threats for at-risk species. Implementation of habitat improvement projects designed to benefit at-risk species can contribute to the local labor force and economy when work is accomplished through contractors.

The presence of some charismatic at-risk species, such as bald eagle and great gray owl, contributes to the recreational activity of viewing nature, which contributes to the local recreation economy. Data from the National Visitor Use Monitoring program for 2007 showed that viewing wildlife was a popular reported recreation activity on the Sequoia National Forest at 34.6 percent. Often the presence of these highlighted species increases the appeal of an area for nature watchers, even if they do not specifically seek these species out.

Management for at-risk species can be used as an indicator of sustainability of forests related to the conservation of biological diversity (USDA-USFS 2011). The trends in the species diversity indicators are provided in Chapter 1 of this assessment.

Information Gaps

Systematic inventories to document the contemporary presence or absence of most at-risk species do not exist. Historic distribution and historic population estimates are not known for most species, although more data generally exists for federally listed species. General accounts from the last 100 years from naturalists, and studies from recent decades allow extrapolation of abundance and distribution. This information gap must be considered in the context of the current and admittedly altered, drivers and stressors. In many cases, due to human encroachment into the wildlands, the permanent or semi-permanent alteration of habitats due to land use changes, and the fundamental alteration of drivers and stressors such as fire, restoration to historic species distributions and population levels cannot be realistically attained.

Similarly, key life history information is lacking or has not been synthesized into a readily available format for some species. Due to personnel and resource constraints, readily available existing information could not be synthesized in time to be included in the Draft of the Sequoia Forest Assessment for some species, particularly plants for the potential list of species of conservation concern. Additional information will be sought for inclusion in the final assessment and throughout the planning process, as needed.

For most amphibian species, a variety of fungal pathogens as a disease agent are a significant concern for population sustainability. These diseases are the focus of many recent and ongoing research efforts. As research information accrues and causal relationships are established, the significance of disease as a key factor can better be evaluated.

The direct and indirect cause-and-effect relationships between effects of disturbance to individuals and from changes in habitats that may cause either positive or negative changes in survival, mortality, and breeding rates does not exist for most species.

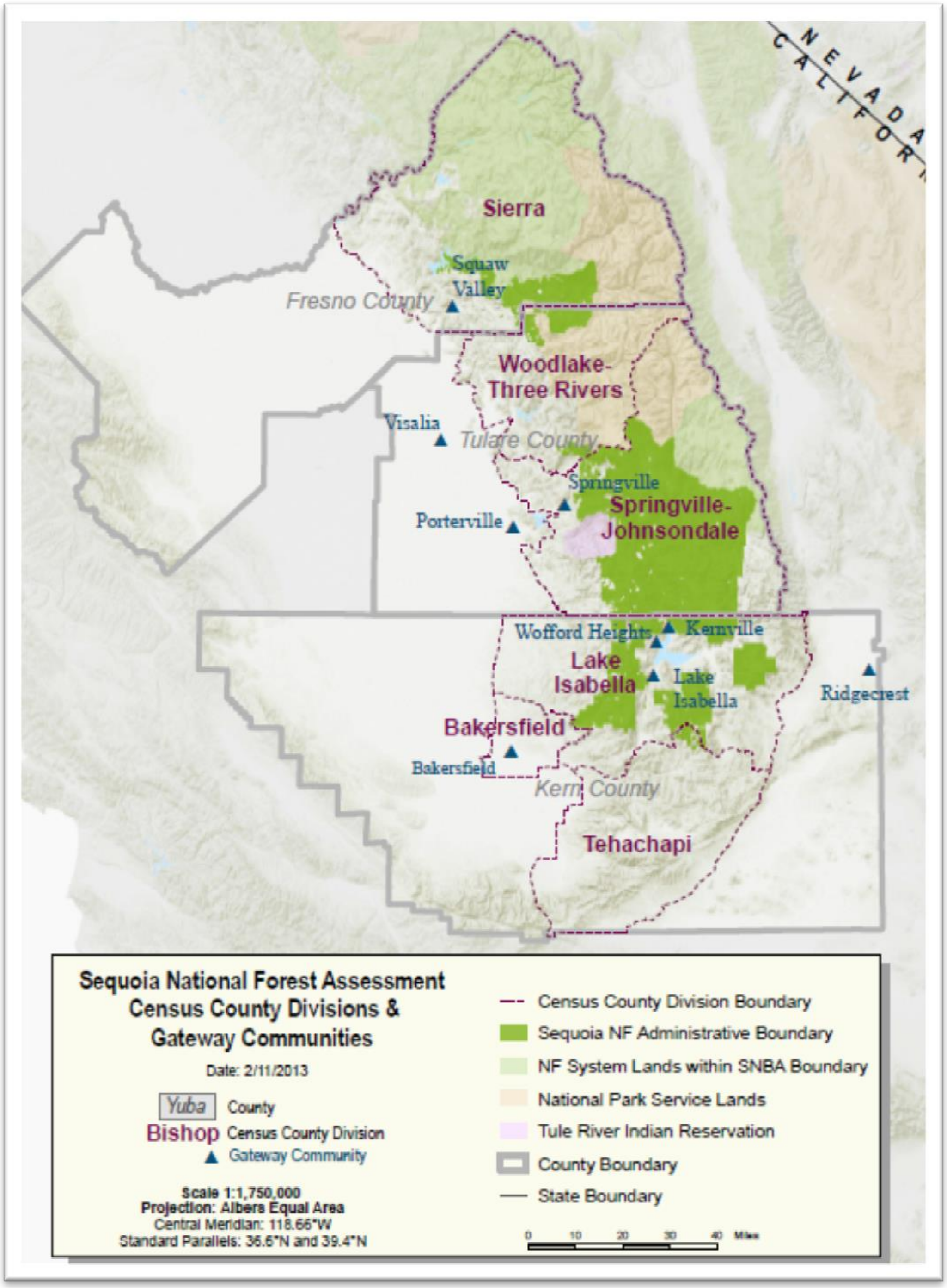
Chapter 6: Assessing Social, Cultural and Economic Conditions

The 2012 Planning Rule for National Forest System (NFS) land management planning recognizes that social, economic, and ecological systems are interdependent and as such, requires the consideration of social, economic, and ecological factors in all phases of the planning process. National forest management can influence social and economic conditions relevant to a planning area, but cannot ensure social and economic sustainability, because many factors are outside the control and authority of the responsible official. For that reason, the 2012 Planning Rule requires that plan components contribute to social and economic sustainability within Forest Service authority, and the inherent capability of the plan area. To accomplish this goal, it is necessary to understand the context of socioeconomic conditions for the Sequoia National Forest. This chapter provides a summary of this context, as well as references to the more detailed socioeconomic information that is available in the snapshot of the Sequoia National Forest Living Assessment Chapter 6.

Important Information Evaluated in This Phase

This chapter focuses on assessing social, cultural, and economic conditions in the Sequoia National Forest's assessment area. However, conditions outside the assessment area can also impact the Sequoia National Forest and conversely, management decisions for the forest can have impacts far beyond the plan area. Therefore, a layering of these scales will be considered and incorporated throughout the chapter where applicable and will provide a more complete picture of the socioeconomic conditions in the Sequoia National Forest's assessment area. Conditions in the assessment area will be compared to conditions in the Sierra Nevada bio-region, in California, and in the United States as a whole.

This chapter presents socioeconomic data for the Sequoia National Forest's assessment area, defined here as the six census county divisions (CCDs) from the three counties that intersect the forest administrative boundary – Fresno, Tulare and Kern. These counties also have large portions of land area that lie outside of the plan area. Therefore, using data for these CCDs rather than for the entire counties provides a closer fit to the geographical footprint of the plan area. Data is also presented for the counties as a whole to allow for a comparison of county conditions to the more local forest conditions. In some cases, such as with the economic portions of this chapter, CCD-level data are not available for many variables and therefore only county-level data is presented.



Sequoia National Forest Assessment Census County Divisions and Gateway Communities Map

In addition to CCD- and county-level information, socioeconomic data for gateway communities in the assessment area is presented. Gateway communities are those that exist in close proximity to the Sequoia National Forest, whose residents and elected officials are often affected by the decisions made in the course of managing the forest, and whose decisions may affect the resources of the forest. Because of this, there are shared interests and concerns regarding decisions. These gateway communities typically offer food, lodging, and other services to forest visitors, in addition to employee housing, and a convenient location to purchase goods and services essential to forest administration (definition adapted from the National Park Service) (National Park Service 2006).

A primary source of socioeconomic data for assessment area, including population, age, gender, race, ethnicity, language, education, housing, poverty levels, household earnings, and employment were taken from the Economic Profile System – Human Dimension Toolkit (EPS-HDT) developed by Headwaters Economics in partnership with the Bureau of Land Management and the Forest Service. Another important source of information was the "Science Synthesis to Support Land and Resource Management Plan Revision in the Sierra Nevada and Southern Cascades," developed by the USDA Forest Service Pacific Southwest Research Station (Long et al. 2013).

For more detailed information on the data sources used for this assessment area, see the August 2, 2013 snapshot of the Sequoia National Forest Living Assessment Chapter 6, lines 36-121.

Nature, Extent and Role of Existing Conditions and Future Trends

This section summarizes: (1) the social, cultural, and economic context of existing conditions and future trends for the Sequoia National Forest; and (2) the social, cultural, and economic conditions influenced by forest management.

Social, Cultural, and Economic Context of the Sequoia National Forest

The focus of this section is to provide the social, cultural, and economic context of existing conditions and future trends for the Sequoia National Forest. This context is important because it influences national forests and forest management. Thus, while forest management can influence social, cultural, and economic conditions, larger socioeconomic forces may be at play that influence decisions and outcomes and the ability to influence some of these conditions.

Historical Context

Similar to the Sierra Nevada bio-region, the Sequoia National Forest has a rich history and culture that has always been deeply connected to the land and its natural resources. Archaeological data indicate that humans have inhabited the Southern Sierra Nevada and portions of the forest for at least 9,000 years, while the mid-19th century brought large scale changes to the area of influence as a result of the Gold Rush. The recognized value of and attempts at protecting the forest’s famous giant sequoia trees began as early as the 1870s, at which time early recreation began in what is today known as the Giant Sequoia National Monument (USFS 2012a).

For more detailed information on this historical context see the August 2, 2013 snapshot of the Sequoia National Forest Living Assessment Chapter 6, lines 152-164.

Cultural Context

The current cultural conditions in the Sierra Nevada in general are deeply tied to the region's rich past and can influence how National Forest System (NFS) lands in the bio-region are used and managed. While, the Native American population is estimated to make up only approximately 1.3 percent of the total population within the Sequoia National Forest's assessment area, it accounts for 14 percent of the total Native American population in the Sierra Nevada bio-region. Sixty-six percent of the Native American population in the assessment area is located in the Springville-Johnsondale CCD in Tulare County. The forest borders over one-half of the Tule River Indian Reservation and approximately 9,000 acres along the upper portion of the South Fork Tule River, to which the Tule River Tribe has water rights, are in the Giant Sequoia National Monument.

Timber harvesting is also a part of the bio-region's cultural heritage and has played a lasting role in shaping community values and identities. Timber communities have a strong sense of place and value close community ties, community self-reliance, and individualism (Kusel 1996). Timber under contract from the Sequoia has been declining over the last 25 years and currently, the forest is providing timber for three remaining sawmills.

Ranching and agricultural lands are an integral part of the region's economy, history, cultural heritage and scenic beauty (Sierra Nevada Conservancy 2011a and 2011b). Ranchers continue to depend on public land grazing to support their livelihood. The central Sequoia foothills are home to many ranchers who have long practiced a system of grazing where they move their livestock seasonally, using the foothills in the winter and Forest Service montane meadows in the summer (Sulak and Huntsinger 2007). Ranching has declined due to shifts in land management priority, societal pressures that have resulted in new policies, reduced rangeland forage production, competing land uses, family demographics, and the marginal economics of livestock grazing (Huntsinger et al. 2010). In 2012, 27 permits were authorized to graze 7,703 cattle within the Sequoia National Forest at various times of the year.

Outdoor recreation is a major part of the culture and lifestyle in the Sierra Nevada and one of the main ways that residents and visitors connect to the land and enjoy the natural world. Recreation plays a significant role in contributing to tourism in the region, which relies on the condition of Sierra Nevada ecosystems (Duane 1996). According to National Visitor Use Monitoring (NVUM) data from 2005-2007, an estimated 640,000 people visited the Sequoia National Forest. Of the ten national forests in the bio-region, the Sequoia National Forest was the seventh most visited forest for recreation. Key visitor activities on the Sequoia National Forest are: fishing, hunting, relaxing, hiking/walking, viewing wildlife, driving for pleasure, viewing natural features and developed camping. Also, many visitors to the Sequoia National Forest come from outside the assessment area with about 20 percent of visitors traveling between 51 and 100 miles and about 37 percent traveling over 100 miles.

For more detailed information on this cultural context see the August 2, 2013 snapshot of the Sequoia National Forest Living Assessment Chapter 6, lines 165-348.

Demographics

The age distribution in the assessment area has shifted toward younger age classes compared to the Sierra Nevada bio-region as a whole. Expanding out to the three-county area reveals an even greater percentage of the population in younger age classes. Both the Bakersfield and Woodlake-Three Rivers CCDs have a majority of their populations under 40 years old with about one-third of their populations under the age of 20. However, age distribution is quite variable across CCDs.

Within the assessment area, there is more racial and ethnic diversity than at all other geographical scales. In 2010, 44 percent of people in the assessment area identified as Hispanic or Latino (of any race), compared to 29 percent in the bio-region, 37 percent in the state, and 16 percent of people in the United States as a whole. Racial diversity is also high in the assessment area, where around 65 percent of people are self-identified as White alone, compared to 75 percent in the bio-region, 61 percent in California, and 74 percent in the country. According to NVUM data from 2011, 14 percent of visitors to the Sequoia National Forest were minorities and people who are Latino or Hispanic accounted for 13 percent of all visitors.

For more detailed information on demographics see the August 2, 2013 snapshot of the Sequoia National Forest Living Assessment Chapter 6, line numbers 515-587.

Settlement Patterns and Housing

Population and settlement growth in the bio-region has largely been driven by a phenomenon known as amenity migration, referring to the movement of people from urban areas to Sierra Nevada forests for their amenity values, such as outdoor recreation opportunities, scenic beauty, and an overall improved quality of life (Loeffler and Steinicke 2007). In the assessment area, 39 percent of the homes in the Springville-Johnsondale CCD are seasonal homes. In addition, between 20 and 30 percent of homes in the Sequoia and Lake Isabella CCDs are seasonal homes. Compared to the rest of the area of influence, more recent housing growth has occurred in the Tehachapi CCD in Kern County, where 40.3 percent of houses were built after 1990 and 7.2 percent were built within the last eight years.

Approximately 46 percent of people who own houses in the assessment area have monthly costs (mortgages, real estate taxes, various insurances, utilities, fuels, mobile home costs, and condominium fees) greater than 30 percent of their household income, which is considered a proxy for unaffordable housing. This is slightly lower than levels in California (52 percent) and the bio-region (48 percent) and higher than the national level (37 percent).

For more detailed information on settlement patterns and housing see the August 2, 2013 snapshot of the Sequoia National Forest Living Assessment Chapter 6, lines 588-643.

Population

According to the Sequoia Business Council (2007), population growth is considered to be the driving force of change throughout the Sierra Nevada. The population in the Sequoia National Forest assessment area grew by 15.4 percent between 2000 and 2010 to 478,143 people. This is slightly more than the 14.6 percent increase that occurred at the bio-regional level and much greater than the approximately 8 percent increase at both state and national levels during this same time period. Within the assessment area, the largest growth in population (26.4 percent) occurred in the Tehachapi CCD of Kern County. By 2050, the population is expected to increase 65 percent in Fresno County, 99 percent in Tulare County, and 117 percent in Kern County (California Department of Finance 2012a).

For more detailed information on population see the August 2, 2013 snapshot of the Sequoia National Forest Living Assessment Chapter 6, lines 349-514.

Human Wellbeing

Poverty rates in the Sequoia National Forest assessment area are higher than the bio-region as a whole. In 2010, the poverty rate in the assessment area was about 21 percent for individuals and 17 percent for families, which compares to 17 and 12 percent, respectively in the bio-region. These poverty rates are heavily influenced by the large number of people and families in the Bakersfield CCD who live below the poverty level.

About 74 percent of people in the assessment area have a high school degree, which is lower than the bio-region (82 percent), state (81 percent), and national (85 percent) levels. The Bakersfield CCD and Woodlake-Three Rivers CCD have the largest percentage of people over 25 years of age who do not have a high school degree. Conversely, in the Sequoia CCD, 92 percent of people have a high school degree.

According to the University of Wisconsin Population Health Institute's County Health Rankings (2013), these three counties are some of the lowest ranked counties in the state for both health outcomes and factors. Fresno and Kern counties have an overall rank of 46 out of 57 counties in California evaluated for health outcomes, while Tulare County ranks 54 out of 57.

According to 2011 data from the Center on Juvenile and Criminal Justice (2012), the three-county area has high reported crime rates (aggravated assault, forcible rape, murder, robbery, arson, burglary, larceny/theft, motor vehicle theft) compared to the rest of the state. A major increase in reported crime rates occurred from 2010 to 2011 across all three counties and the state as a whole.

For more detailed information on human wellbeing see the August 2, 2013 snapshot of the Sequoia National Forest Living Assessment Chapter 6, lines 644-755.

Economic Health

The unemployment rate in 2011 for the counties bordering the Sequoia National Forest was 15.9 percent, higher than both the bio-region (14.3 percent) and the state (11.7 percent). In addition, 2011 average earnings in these counties ($49,194) as well as per capita income ($30,782) were lower than in both the bio-region ($50,093 earnings and $35,574 per capita income) and the state ($60,453 earnings and $43,856 per capita income). With higher unemployment, lower earnings and lower per capita income, the counties bordering the Sequoia National Forest are facing greater challenges to economic health than the state and bio-region as a whole.

For more detailed information on economic health see the August 2, 2013 snapshot of the Sequoia National Forest Living Assessment Chapter 6, lines 809-844.

Economic Diversity

When determining the economic context of forest management decision making, it is important to identify the key sectors that drive the economy and the extent to which the economy is dependent on forest land activities. Determining this level of diversification and the economy's dependence on these forest land activities provides a good indicator of the potential effects that may result from forest management decisions that impact these activities. The economies of the assessment area are diversified with low to no specialization across all CCD's (Lin and Metcalfe 2013). The diversity of these economies will be impacted by future trends and changes in employment levels across economic sectors. Employment projections by occupation show that the greatest increases over this decade are expected in the healthcare, personal care and service occupations, while forest-related sectors are expected to grow at a slower pace (California Department of Finance 2012b). This suggests that future trends in employment will not lead to an increased concentration of employment in forest-related sectors.

For more detailed information on economic diversity see the August 2, 2013 snapshot of the Sequoia National Forest Living Assessment Chapter 6, lines 845-901.

Gateway Communities

The gateway communities identified for the Sequoia National Forest include: Bakersfield, Kernville, Lake Isabella, Porterville, Ridgecrest, Springville, Squaw Valley, Visalia, Wofford Heights and the Tule River Indian Reservation. These communities range from larger urban areas (e.g. Bakersfield and Visalia with populations of 331,868 and 119,312 respectively) to smaller rural communities (e.g. Springville and the Tule River Indian Reservation with populations of 1,269 and 566 respectively). Racial makeup is also different across these communities, with minorities comprising as little as 4 percent of the population in Wofford Heights, to as much as 40 percent in Bakersfield and 94 percent in the Tule River Reservation. Unemployment ranges from a high of nine percent in Squaw Valley to a low of one percent in Kernville. Median household income varies greatly from a high of $57,693 in Ridgecrest to a low of $19,627 in Lake Isabella.

For more detailed information on these gateway communities see the August 2, 2013 snapshot of the Sequoia National Forest Living Assessment Chapter 6, lines 902-904.

Forest Service Influence on Key Social, Cultural, and Economic Conditions

This section identifies key social, cultural, and economic conditions influenced by management of the Sequoia National Forest. Many of the conditions previously identified provide useful context, but may not be substantially influenced by the management of the plan area to be included here. Where information is available, trends affecting these conditions are identified. At the end of this section, there is a discussion of potential opportunities for the Sequoia National Forest to contribute to social, economic, and ecological sustainability.

Key Social Conditions

Many people in the Sierra Nevada feel a deep connection to the land and its history. As described in Winter et al. (2013a, p.2):

> Attachment to the natural environment, influenced by natural landscapes and views, presence of wildlife, and opportunities for outdoor recreation is a component of community attachment and wellbeing.

National forests in the Sierra Nevada play a major role in fostering people's connection to nature, particularly through recreation, education, and interpretation.

According to National Visitor Use Monitoring (NVUM) data from 2011, the most popular recreation activities on the Sequoia National Forest included fishing, relaxing, hiking/walking, viewing wildlife, driving for pleasure, viewing natural features, developed camping, picnicking, nature study activities and other non-motorized activity. Visitor satisfaction from NVUM data can provide some sense of people's ability to connect to the land through the quality of their experiences. Overall visitor satisfaction in 2011 was high for the Sequoia National Forest with 85 percent of visitors very or somewhat satisfied with their visit.

For more detailed information on connecting with the land see the August 2, 2013 snapshot of the Sequoia National Forest Living Assessment Chapter 6, lines 913-1032.

Being with friends and family is one of the main motivations for why Californians pursue outdoor recreation opportunities (Roberts 2009). In November 2012, the Forest Service, through its Central California Consortium (CCC), held a youth workshop at the Sierra National Forest Supervisor's Office in Clovis, California. The purpose of this workshop was to have a discussion with youth and underserved communities about forest planning, why it matters to them, and ways to get young people and their families involved. A recurring response was that being with friends and family made them happy, and forests provide opportunities for spending time with friends and family. According to NVUM data, children under the age of 16 accounted for more than 20 percent of visitors to the Sequoia National Forest in 2011, compared to 29 percent in 2006.

For more detailed information on social interactions see the August 2, 2013 snapshot of the Sequoia National Forest Living Assessment Chapter 6, lines 1033-1095.

National forests contribute to the wellbeing of human populations in the Sierra Nevada. People who feel connected to nature are not only more likely to protect nature, but also more likely to feel satisfied with their lives (Mayer and Frantz 2004). "The connections between human health and forests hold great potential for improvement of wellbeing" (Winter et al. 2013a, p.2). Outdoor locations offer unique opportunities to recreate and relax, providing physical and social health benefits, a chance to develop a basis for stewardship, a place to celebrate culture and family, and a place for restorative experiences (Winter et al. 2013a).

For more detailed information on health, safety and education see the August 2, 2013 snapshot of the Sequoia National Forest Living Assessment Chapter 6, lines 1096-1160.

Key Cultural Conditions

Many Sierra Nevada residents share values around the rural and environmental qualities of the region to which National Forest System lands contribute. A 1995 survey found that maintaining the rural character of the region is important to the majority of these residents. In addition, residents strongly supported expanded efforts to preserve the region's natural resources, wanted to see their counties put more effort into conserving the natural environment, felt their counties should be doing more to permanently preserve open space and agricultural lands, and should do more to steer new development into existing towns instead of allowing it to spread all over the landscape and destroy the rural quality of life (Sequoia Business Council 1997).

For more detailed information on community values see the August 2, 2013 snapshot of the Sequoia National Forest Living Assessment Chapter 6, lines 1162-1234.

Sierra Nevada national forests provide opportunities for people to connect with the history and culture of the region, and to create new contributions to the region's culture and future legacy. The Sequoia National Forest contributes to these opportunities through its cultural and historical resources. Key examples include:

- The Walker Pass Pioneer Trail, listed as a National Historic Landmark
- Hydroelectric power generation systems and agricultural water and flood control systems built on the forest and managed as resources eligible for the National Register of Historic Places
- Hume Lake Dam which may also qualify in the future as a National Historic Landmark (USFS 2012a).

For more detailed information on cultural connections see the August 2, 2013 snapshot of the Sequoia National Forest Living Assessment Chapter 6, lines 1235-1282.

In the Native American community, subsistence use of forests denotes a lifestyle involving a deep connection to nature and cultural traditions (USFS 2011). Many Native Americans participate in traditional activities, such as hunting, fishing, trapping, and gathering berries, and do not differentiate these activities into distinct categories, such as work, leisure, family, culture, and tradition (McAvoy et al. 2004). Potential issues affecting traditional Native American gathering on the Sequoia National Forest include climate change, competitive uses, recreation impacts, grazing, wildland fire, traditional burning, fuels and vegetation management to clear non-native or encroaching vegetation, intensive fuel loading, and vegetation management. Non-tribal groups also use the Sequoia National Forest for traditional and cultural purposes. According to 2011 NVUM data for the Sequoia National Forest, 3.9 percent of visitors participated in gathering forest products and less than one percent of visitors reported it as the main reason for visiting the forest. However, the data do not differentiate between tribal and non-tribal gathering.

For more detailed information on traditional uses see the August 2, 2013 snapshot of the Sequoia National Forest Living Assessment Chapter 6, lines 1283-1360.

Key Economic Conditions

Contributing to community wellbeing by providing a broad range of economic opportunities for forest communities is consistent with current Forest Service direction from the U.S. Department of Agriculture (USDA) to generate jobs through recreation and natural resource conservation, restoration, and management in rural areas (USDA 2010). Federal forest management alone cannot ensure community stability, as jobs in the forest products and recreation industries are influenced by market conditions and changes in technology that are outside the control of forest management. As a result, National Forests cannot expect to ensure community economic wellbeing through their management actions alone (Charnley 2013). Strategies can be developed that allow forests to achieve management objectives while simultaneously considering the effects on local wellbeing. Timber, recreation and agricultural production on national forest lands continue to make important contributions to some local communities.

As of 2010, timber sector jobs in the counties bordering the Sequoia National Forest made up a small percentage of total private sector employment. This timber employment accounted for around 0.6 percent of all private sector jobs in the counties (an estimated 2,711 jobs out of the 485,432 in the counties), which is a similar percentage to the state and the bio-region. Within the timber sector, wood products manufacturing accounts for most of this employment (2,304) with very few jobs occurring in sawmills and paper mills (382) and in the growing and harvesting industries (25) . Total employment in the timber sector has decreased from around 0.8 percent of all private sector employment in 1998 to the 0.6 percent level of today (Headwaters Economics 2012a).

The 2011 annual wage averaged across all economic sectors in these counties is $38,239, which is lower than the state average of $55,005 and the bio-region average of $42,776. The average annual wage for timber employment in these counties is $41,310, again lower than the $44,759 average earned in the bio-region. As in the bio-region, paper manufacturing pays the highest wage in the timber sector ($50,159) and forestry and logging pays the lowest ($21,632) (Headwaters Economics 2012a).

Mining sector jobs in 2010 in the counties bordering the Sequoia National Forest made up 1.4 percent of all private sector jobs in the counties (an estimated 6,902 jobs out of the 485,432 in the counties), which is more than the state and the bio-region. The majority of this employment is in the oil and gas sector in Kern County (5,885 jobs), none of which is derived from the Sequoia National Forest. Therefore, outside of this energy sector in Kern, mining is a relative small portion of the total workforce. The average annual wage for mining employment in these counties is $84,975, which is much higher than the average wages across all sectors ($38,239). This high average wage for mining is similar to the bio-region and indicates that the number of jobs in the mining sector may be low but they are relatively high paying jobs when compared to the rest of the local economy (Headwaters Economics 2012a).

Pasture and rangelands within the counties bordering the Sequoia National Forest comprise around 43 percent of the total land area in farms, which is less than the percentage for the state (52.3 percent) and bio-region (53 percent) (USDA 2009). Cattle, sheep and goats account for around 12 percent of all farming operations, less than the bio-region (22.5 percent) and the state (17.5 percent) (USDA 2009). Farm employment in these counties accounts for 5.6 percent of all employment, higher than for the bio-region (3.2 percent) and the state as a whole (1.2 percent) (U.S. Department of Commerce 2012). Limitations of this employment data include the fact that farm employment cannot be broken down by type of activity, so this specialization includes all types of agricultural employment not just grazing and livestock operations.

In 2010, travel and tourism related industries comprised 15.6 percent of jobs in the counties bordering the Sequoia National Forest, which is similar to the bio-region (18.1 percent) and the state (15.7 percent) (U.S. Department of Commerce 2012). The number of jobs in this sector has been relatively stable ranging around 15 percent of total private employment from 1998 through 2010. The average annual wage in the travel and tourism sector is $16,036, far below the $38,239 average for all private sector jobs. So while the travel and tourism sector may provide a lot of employment opportunities in the area, they are relatively lower paying jobs (Headwaters Economics 2012a).

A study examining the value of travel and tourism to California counties estimated the percentage of total county employment and earnings that is generated by all travel in the county. Travel and tourism generates 3.7 percent of employment and 1.6 percent of earnings in Kern County, 2.9 percent of employment and 1.5 percent of earnings in Fresno County and 2.5 percent of employment and 1.5 percent of earnings in Tulare County (Dean Runyan and Associates 2012). A study looking specifically at the contributions from recreational use of National Forest system land found that employment created by recreation activities specifically in the Sequoia National Forest in 2008 is only a small percentage of the local economic activity surrounding the forests (0.1 percent of total employment and 0.08 percent of total income in the area) (USFS 2008).

Examining the flow of water from the Sequoia National Forest shows the economic importance of this ecosystem service. Watersheds of the forest drain into the Tulare Buena Vista Lakes Hydrologic Province and contribute to municipal, agricultural, recreation, warm and cold freshwater habitat, groundwater recharge and freshwater replacement. The benefits to people from all of these uses are extensive. Hydropower generation occurs on the Kern and Tule Rivers, while industrial uses and groundwater recharge are downstream of its dams (State Water Resources Control Board 2004). Six Federal Energy Regulatory Commission (FERC) projects lie within the forest plan boundary.

For more detailed information on key economic sectors and contributions of the Sequoia National Forest see the August 2, 2013 snapshot of the Sequoia National Forest Living Assessment Chapter 6, lines 1379-1501.

Local governments rely on revenue generated from activities on forest lands. Management decisions that affect these activities have the potential to impact these revenues. Key sources of these revenues are: (1) the sales taxes generated from timber sales and tourism and (2) direct revenue received from the Payments In-Lieu of Taxes (PILT) and Secure Rural Schools and Community Self-Determination Act (SRS) programs.

The counties bordering the Sequoia National Forest receive revenue from sales taxes on timber products and on temporary lodging from visitors to the area. Available data shows that these sources of tax revenue are a small percentage of the total county revenues for the area as a whole (0.1 percent) but this is larger than the average for the bio-region (0.5 percent) suggesting that these counties are more sensitive to changes in this revenue than the bio-region as a whole. Specifically, it is the transient lodging tax revenue that is the more significant contributor of the two tax sources (California State Controller's Office 2012). It should be noted that while the Sequoia National Forest does contribute to travel and tourism in these counties and therefore can influence this transient tax revenue, there are other recreational opportunities in the bio-region that also drive this tourism, such as other national forests and national parks, and therefore all of this revenue cannot be attributed to visitors to the Sequoia National Forest alone. One study estimated the percentage of county sales tax revenue that is visitor related. This includes spending on goods and services while visiting an area and this visitor spending accounts for 5.3 percent of sales tax revenue in Fresno County, 4.6 percent in Kern County and 3.6 percent in Tulare County (Dean Runyan and Associates 2012).

All of the counties bordering the Sequoia National Forest received some level of PILT in FY 2009. These values were Tulare ($3.2 million), Fresno ($3 million) and Kern ($2.6 million). These values alone do not reflect the importance of these revenues to individual county budgets. Instead, looking at these PILT revenues as a percentage of total county revenues provides a measure of the importance of this contribution. For all three counties, this percentage is very small (around 0.5 percent or less) (Headwaters Economics 2012b).

For more detailed information on fiscal conditions see the August 2, 2013 snapshot of the Sequoia National Forest Living Assessment Chapter 6, lines 1502-1551.

Forest Service spending for the Sequoia National Forest has increased from around $10.5 million in 2006 to around $20 million in 2012 mostly as a result of increases in the budgets for wildland fire management – spending for fuel reduction and fire preparedness (USFS 2012b). In terms of total federal spending in the counties bordering the forest, this amounts to only a very small percentage of the approximately $12 billion in total federal government expenditures in these counties in FY 2006, and is an even smaller percentage of the total economic output across all sectors of the economy over this time period (California Department of Finance 2009).

Contributions the Plan Area Makes to Ecological, Social or Economic Sustainability

The history and changes of the Sierra Nevada create a complex environment for national forest management. Maintaining a cultural legacy is important to communities. At the same time, community wellbeing depends on the ability of those communities to adapt to a changing, uncertain future. Individuals and communities far beyond the Sierra Nevada influence the sustainability of forests and communities in the bio-region, and are likewise influenced by management decisions that take place on national forests in the bio-region. Now there is a much richer understanding of the social, economic, and ecological factors in land management decisions. While challenging, this complexity highlights the robust opportunities available to the Forest Service to contribute to social, economic, and ecological sustainability. Socioeconomic factors important to this sustainability are:

- community capacity
- ecological restoration
- working together
- sustainable recreation
- connecting people to nature

Community capacity is critical to wellbeing in forest communities, and can be defined as the ability of its residents to respond to internal and external stresses, create and take advantage of opportunities, and meet the needs of residents (Kusel 2001). This capacity influences the ability of communities to prepare for and adapt to change and stressors such as wildland fire and climate change (Charnley 2013).

People who live in rural communities in the Sierra Nevada are concerned about their future. Many traditionally resource-based communities in the Sierra Nevada are in a transition period. New people have moved in from urban areas, bringing different values and changing the demographics of communities. Ecological concerns, federal policies, and competing land uses have influenced timber harvesting and grazing. Outdoor recreation and tourism have brought new economic opportunities to communities that were formerly dependent on timber. Population growth, increased demand for recreation, competition for different uses, and ecological concerns bring with them additional challenges. In addition, tribal communities continue to struggle with maintaining a culture that is directly tied to management of and access to ancestral lands and sacred sites. Many people who live outside the Sierra Nevada are also dependent on the bio-region's ecosystem services, which can impact Sierra Nevada forests and local communities. More detail on sources of information on the role of community capacity can be found in the August 2, 2013 snapshot of the Sequoia National Forest Living Assessment Chapter 6, lines 1586-1624.

Ecological Restoration

Management of National Forest System (NFS) lands in the Sierra Nevada can contribute to community capacity by helping people become stewards of the land as participants in ecological restoration activities

(Charnley 2013). This engagement is empowering because people personally partner with land management agencies to find solutions (Charnley 2013).

Healthy forests and healthy communities are interdependent, and ecological restoration not only helps improve ecological conditions, but also offers positive outcomes for individuals and communities (Charnley 2013). Ecological restoration connects people to the land and to each other, helping communities build collective identities tied to land stewardship (Charnley 2013). Stewardship contracting is thought to be an effective tool for enhancing social and economic benefits to local communities (Charnley 2013).

Current policy for national forest management calls for approaches that accomplish ecological restoration goals, while simultaneously producing forest products that can benefit local communities (USDA 2010, USFS 2007). Ecological restoration as a policy in the bio-region can contribute to reducing current trends in fire, while simultaneously contributing to the sustainability of local community wellbeing. Specifically, restoration projects that support the local wood product economy also provide the opportunity to support local residents in rural areas who rely on the forest for their livelihoods. For example, a study has estimated that between 13 and 29 jobs are created or retained, and over $2.1 million in total economic activity is generated for every $1 million that is invested on restoration (Moseley and Nielsen-Pincus 2009). In addition, rural communities in the wildland urban interface (WUI) are economically connected with key forest sectors as they rely on activity in timber, grazing and recreation. A reduction in uncharacteristic wildfire as a result of restoration reduces the potential for damage to the resources on which these forest sectors are dependent. Therefore, restoration reduces the potential for disruption on the livelihood for many of the residents in these communities (Zybach et al. 2009).

Not only is restoration a potential benefit to these rural communities, but economically healthy local communities are also a benefit to the success of Forest Service restoration goals. Given the desire to increase the pace and scale of restoration, maintaining a robust local workforce and local infrastructure is necessary to support the logistics and economics of restoration (Charnley and Long 2013, Charnley et al., in press). This is because the revenue that can be generated through stable local markets for timber and non-timber biomass from restoration activities can help offset the costs of Forest Service restoration goals. In addition, the further the haul distance from the harvest site to the processing facility, the higher the transportation costs and less economical the timber sale. Therefore, maintaining local wood processing infrastructure in the bio-region is an important strategy for maintaining favorable economics for accomplishing ecological restoration goals while sustaining jobs in the local wood products industry (Charnley and Long 2013, Charnley et al., in press).

For more detailed information on the role of ecological restoration see the August 2, 2013 snapshot of the Sequoia National Forest Living Assessment Chapter 6, lines 1625-1669.

Working Together

As the Chief of the Forest Service said (Tidwell 2010) in order to restore the resilience of America's forests and grasslands to disturbances of all kinds, we need to work at a scale that supersedes ownerships. Specifically:

> An all lands approach brings landowners and stakeholders together across boundaries to decide on common goals for the landscapes they share. It brings them together to achieve long term outcomes. Our collective responsibility is to work through landscape-scale conservation to meet public expectations for all the services people get from forests and grasslands.

Charnley (2013 p.15) found:

> A number of researchers have found that when the Forest Service works collaboratively with local communities to develop forest restoration projects that build on local community infrastructure, resources, values, culture, and collaborative relationships and address local needs and priorities, it can be especially effective in creating local community benefits and contributing to community resilience. It is not always easy to collaborate, given declines in agency staffing and resources, and there can be challenges in the process. Nevertheless, when opportunities exist to develop projects collaboratively and align them with community needs and capacity, they are more likely to create local community benefits.

For more detailed information on the role of working together see the August 2, 2013 snapshot of the Sequoia National Forest Living Assessment Chapter 6, lines 1670-1704.

Sustainable Recreation

Outdoor recreation is major part of the culture and lifestyle in the Sierra Nevada, and in California in general. The social, economic, and ecological benefits are numerous. Outdoor recreation contributes to people's connection to nature, sense of place, and community identity. It provides physical and mental health benefits, and a foundation for stewardship. Recreation supports social interactions with friends and family, which is especially important in the Latino community. There is growing recognition of the importance that recreation volunteerism plays in California, in maintaining the quality of opportunities, as well as restoring ecosystems. Recreation is an important part of California's tourism portfolio. Population growth and resulting increases in recreation and tourism have brought new economic opportunities to many Sierra Nevada communities. The most economic activity the Forest Service generates is through recreation special uses (USFS 2010).

Recreation in the Sierra Nevada, compounded by various stressors to the system, can also have negative impacts on social, economic, and ecological conditions. Recreation on national forests can impact the spread of invasive species. Unmanaged recreation can adversely impact natural resources. Population growth has led to increased competition for water among various uses. Increasing numbers of outdoor recreationists can lead to increased conflict, and a lesser quality of experience. Recreation and tourism have led to an influx of urbanites into Sierra Nevada communities, which can increase the cost of living, and result in shifting values (USFS 2010).

The Framework for Sustainable Recreation provides focus areas that help us contribute by shaping the role of recreation in promoting forest and grassland health and strengthening the vitality of our communities (USFS 2010).

Connecting People

The economy relies on society, and society is dependent on the environment. This is the general premise of the Millennium Ecosystem Assessment (2005), which recognized the growing burden degraded ecosystems are placing on human wellbeing and economic development. It points out that sustaining the benefits ecosystems provide for human wellbeing requires a full understanding and wise management of the relationships between human activities, ecosystem change, and wellbeing in the near and long term future.

The importance of the connection between people and Sierra Nevada forests is clear. Specific and comprehensive data on people's connection with and understanding of Sierra Nevada forests is largely unavailable. However, it is clear that many people outside the Sierra Nevada feel a deep connection with the forests in the bio-region. It is important to continue to foster these connections. At the same time, many people who benefit from resources originating on the forest, such as water and electrical power, may not be aware of these benefits and may never visit (USFS 2012a). All are potential advocates, however. Several opportunities occur for developing connections where they do not yet occur, especially in many urban communities, where water demand, resource demand, and pollution all influence the health of Sierra Nevada ecosystems. Ecosystem services can be a useful framework for forest stewardship (Smith et al. 2011), by helping stakeholders identify and understand services provided by a landscape and human use and dependence on those services.

Another important piece of connecting people to Sierra Nevada forests is the major changes in ethnic composition occurring within and just outside the Sierra Nevada, as well as in the country as whole. According to Winter et al. (2013b, p.8):

> Increased cultural diversity in California will continue to be reflected through immigration of Latinos and Asians into Sierra Nevada communities, thus increasing the importance of attending to cultural influences and values of long-standing and newly immigrated residents. These dimensions of diversity add to the already diverse demographic, economic, and ethnic profile of Sierra Nevada communities. Both new and existing populations will challenge modes of outreach, engagement, and approaches to management. Particular attention will need to be paid to groups who may be underserved or underrepresented in opportunities to have their opinions heard, needs or interests represented in decisions about how places will be managed, and opportunities to use their public lands.

For more detailed information on the role of connecting people see the August 2, 2013 snapshot of the Sequoia National Forest Living Assessment Chapter 6, lines 1734-1807.

Information Gaps

While it does provide readily available information, there are limitations to using U.S. Census Bureau – American Community Survey (ACS) data to describe local demographics. ACS data provide estimates of the average characteristics of population and housing from 2006 to 2010 and cannot be used to describe any particular year during that period. The ACS uses samples to estimate demographic data for the entire population of interest and is subject to error. Less populated areas, such as gateway communities and some CCDs, tend to have lower accuracy than at larger scales. As noted earlier, some communities were too small to be included in the ACS.

Social and cultural data specific to the Sequoia National Forest is fairly limited. National Visitor Use Monitoring (NVUM) data provide the most relevant data specific to Sequoia National Forest visitation. While NVUM provides useful information on those already visiting the forest, it does not provide any insight into those people who do not use the forest and why. Also, while there is general or state-level information regarding the importance of national forests, other public lands, and outdoor experiences on human and community wellbeing, little information specific to the Sequoia National Forest is available. It would be helpful to have information regarding the importance of other motivations for visiting the forest beyond activities listed in NVUM, such as spending time with friends and family, physical and mental health benefits, and connecting with culture and history.

Economic data are not available at the local community level to identify the specific context of condition and trend for economic health, economic diversity and forest sector activity. Currently, this information is presented at the county and sub-county (Census CCD) level where available. Going forward during the collaboration phase, it will be useful to collect any data local governments and organizations may provide to describe these more local economic conditions. Also, where data are not available, qualitative information would be useful to help describe local context and characteristics. Another current gap in economic information includes detailed information on direct forest spending in local economies, for example how much spending goes to local businesses as opposed to businesses that are located outside of these local communities. This is important for accurately identifying the impacts of this spending and importance to local job creation and wages.

Another important information gap from an economic perspective is data that can be used to prioritize the benefits to people from ecosystem services so that tradeoffs, both short term and long term, can be evaluated, compared and contrasted. Ecosystem services are the benefits that people obtain from ecosystems and therefore these services have a value to everyone. However, because these values are often difficult to quantify, impacts on these services can often be neglected during forest planning. The term "value" is used here to represent something more inclusive than a monetary or dollar value, but rather to capture the idea that benefits, even when they are not directly relatable to dollars spent or received, are still able to contribute to improving the quality of people's lives. Examples of these types of nonmonetary benefits are provided by key ecosystem services such as cultural heritage and biodiversity. In contrast, examples of key services tied to existing markets and therefore more directly related to monetary value are some aspects of recreation, timber and water. More detail on this topic can be found in Chapter 7 of this assessment.

Chapter 7: Benefits to People

The Sequoia National Forest provides many benefits to the American people. The spectacular features and landscapes provide high quality settings for a wide variety of outdoor recreational activities as well as other ecosystem services. High elevation ridgelines defined by towering conifers, groves of giant sequoia, steep canyons carved by whitewater rivers and huge granite monoliths epitomize the Sequoia National Forest landscapes. The forest is a gateway to the Sequoia and Kings Canyon National Parks and contains the Giant Sequoia National Monument within its boundaries attracting visitors from all over the world.

Ecosystem services such as recreation are enjoyed directly by individuals and communities. Other vital ecosystem services that may be less apparent in daily life include a consistent, clean water supply, hydroelectric power, and a source for forest products.

Important Information Evaluated in this Phase

This assessment identifies and examines seven key ecosystem services provided by forests across the bio-region:

- Water
- Hydropower
- Timber
- Carbon

- Recreation
- Cultural Resources
- Biodiversity

These key ecosystem services were chosen because:

- They are a subset of the services that were examined for the bio-region as a whole and determined to require a consistent approach to management across forest boundaries;
- They have been identified as important to people in the broader landscape as people enjoy these services on the forest, communities surrounding the forest are benefiting from these services and people far from forest boundaries receive benefit from these services as well; and
- They are likely to be affected by the plan alternatives.

The condition and trend of these ecosystem services are dependent on the underlying resources that support them. Therefore, the information for this chapter relies on the specific resource assessments that were conducted in the other chapters of this assessment.

Nature, Extent and Role of Existing Conditions and Future Trends

This section examines the nature, extent and role of existing conditions and future trends for the key ecosystem services of the Sequoia National Forest.

Water

Water is important for use, hydropower and supporting recreational opportunities. More information on the current conditions and trends for water can be found in Chapters 2 and 8 of this assessment.

The lands of Sequoia National Forest provide water supply, hydropower and recreational opportunities. Though the Sierra Nevada only contributes a portion (28 percent) to California's water, its runoff accounts for a larger proportion of the developed water resources and is critical to the state's economy. In fact, the rivers of the Sierra Nevada supply most of the water used by California's cities, agriculture, industry and hydroelectric facilities. The storage and conveyance systems developed to utilize the water resources of the Sierra Nevada are perhaps the most extensive hydro-technical network in the world (Kattlemann 1996). The recreational and aesthetic qualities of the rivers and lakes also attract visitors throughout the country and the world.

The condition and trend of the key ecosystem services for water examined here are water supply, hydropower and water recreation. More information on these topics can be found in Chapters 8, 9 and 10 of this assessment.

Watersheds of the Sequoia National Forest drain into the Tulare Buena Vista Lakes Hydrologic Province and contribute to municipal, agricultural, recreation, warm and cold freshwater habitat, groundwater recharge and freshwater replacement. The benefits to people from all of these uses are extensive from the water originating on the forest.

Hydropower generation occurs on the Kern and Tule Rivers while industrial uses and groundwater recharge are downstream of its dams (State Water Resources Control Board 2004). Six Federal Energy Regulatory Commission (FERC) projects lie within the forest plan boundary: Borel, Kern Canyon, Kern River No. 1, Upper Tule, Lower Tule and Kern River No.3. Each of these projects has minimum in-stream flow requirements for fish.

Families with children, youth, and seniors are large markets for outdoor recreation and will grow (Sheffield 2005). This area of the Sierra Nevada will experience the largest population growth in nearby urban areas, particularly in Bakersfield and Fresno, during the next few decades (Duane 1996). Survey results from National Visitor Use Monitoring (NVUM) show an increase of recreational use between 2005 and 2011 on the Sequoia National Forest. Visitors to the forest who fished increased from 25 percent to 48 percent. Additionally, there is an increase in use of facilities related to waterways. Camping and day use sites along waterways have also seen an increase in use. The public is developing higher expectations for quality and service. Visitors will be interested in a diversity of conveniences and amenities (Sheffield 2005). Whitewater boating is important on the Kern River. Motor boating, water skiing, jet skiing, sailing, and windsurfing are popular at Lake Isabella. Non-motorized boating is popular at Hume Lake.

The population of California is expected to grow 37 percent between 2010 and 2050. This will require additional water in order to meet the needs of more people (California Department of Finance 2012, California Department of Forestry and Fire Protection 2010). Growth is expected to be greatest in the South Sequoia sub-region counties near the Sequoia National Forest of Fresno, Kern, and Tulare. This expected population growth will only increase the competition for these various water uses in the state and the bio-region.

Climatic predictions for California include increased warming, smaller snowpack, and earlier spring snowmelt. These changes would influence the amount of water supply that can originate from forest lands through reduced precipitation, as well as the amount and types of vegetation on forest lands that would influence the timing of water supply. Climate change is also expected to increase the potential severity and area of fire events, which would also impact the condition that influence the timing of water supply.

For more detailed information on water as an ecosystem service see the August 2, 2013 snapshot of the Sequoia National Forest Living Assessment Chapter 7, lines 76-162.

Timber

Timber is important to the local ecology in terms of the benefits of restoration activities, as well as to local economies in terms of the job opportunities and economic activity generated. There is also a larger scale benefit in terms of the timber products that are produced. More information on the current conditions and trends for timber can be found in Chapter 8 of this assessment.

Approximately 75,000 acres of productive forest land is available on the Sequoia National Forest. The five year (2008-2012) average timber volume sold on the forest is 3,800 Mbf. Annually, the timber harvest from the Sequoia National Forest comes from approximately two to three thinning projects, one public safety hazard removal project, and projects removing trees from special use permit areas. Timber under contract on the Sequoia has declined over the last 25 years.

The Sequoia National Forest provides timber for three remaining sawmills, Sequoia Forest Products in Terra Bella, California, and Sequoia Pacific Industries in Chinese Camp, California and Standard, California. The Sequoia Forest Products mill is the last remaining mill in California south of Yosemite. Sequoia Forest Products also operates a wood-fired electrical power plant co-located with its mill.

An analysis of the Sequoia National Forest for the years 2000 to 2011 indicates wildfire occurred on 338,334 acres, including 160,217 acres of productive forest. Wildfires were responsible for the loss of 85,284 acres of productive forest. This is approximately 19.3 percent (or 1.6 percent annual) of the total available productive forest on the Sequoia National Forest (USFS 2004, Miller and Safford 2008). The resulting loss of inventory and potential growth has major implications on the ability of the forest to produce planned sell volumes.

The Sequoia National Forest has experienced significant mortality of white fir, due to high stand densities and over stocked stands. The trend to rapidly grow to overstocked conditions due to the relative recent historical stand development of modern accretions of young shade tolerant less fire-resistant tree species (white fir and incense cedar) puts them at risk for both fire and insect and disease mortality elements. Most timber sales on the Sequoia National Forest are based on restoration and fuels reduction needs. Two recent projects, Breckenridge and Rancheria, are primarily planned to reduce the threat of fires to mountain communities within the forest boundary.

For more detailed information on timber as an ecosystem service see the August 2, 2013 snapshot of the Sequoia National Forest Living Assessment Chapter 7, lines 163-220.

Carbon

Forests play an essential role in global carbon storage, by removing carbon dioxide (CO_2) from the atmosphere and by storing carbon as biomass within ecosystems. Increases in atmospheric CO_2 over the last century have been linked to rising temperatures. Because forests absorb CO_2, they play an important role in regulating climate, which benefits people around the globe. More information on the current conditions and trends for carbon can be found in Chapter 4 of this assessment.

Estimates have been calculated for the carbon sequestered on the forestlands of the Sequoia National Forest. Forestlands are defined here as being composed of at least 10 percent cover by live trees of any size, including land that formerly had such tree cover and that will naturally or artificially be regenerated (Smith et al. 2005). The forest has the seventh highest forest carbon density out of the ten national forests in the bio-region. Other important landscapes contributing to carbon sequestration are shrublands and meadows. There are no Sequoia National Forest specific estimates for carbon in these landscapes, but studies have been done to show that these are important areas for sequestration (Meyer 2012, Norton et.al. 2006, Janzen 2004).

A Forest Service study conducted an assessment of carbon sequestration capabilities of the national forests in California over the next 100 years (USFS 2009). The assessment analyzed forest growth, disturbance, and management options under a range of management scenarios for national forests in California. The analysis concluded that under current forest management activities, over the next four to six decades, California national forests will accumulate carbon at a higher rate than carbon will be lost, although at a decreasing rate because of increased carbon loss through disturbances such as wildfire, insect and disease related pest mortality and inter-tree competition. At some point in the mid-21st century, carbon losses from wildfire, disease and other disturbances will exceed growth, and national forests in California will become net emitters of carbon.

For more detailed information on carbon sequestration as an ecosystem service see the August 2, 2013 snapshot of the Sequoia National Forest Living Assessment Chapter 7, lines 221-262.

Recreation

More information on the current conditions and trends for recreation can be found in Chapter 9 of this assessment.

Recreational opportunities on the Sequoia National Forest attract visitors and provide the benefits of outdoor recreation activities to people from neighboring counties, around the state, across the country and around the world. Visitors make contributions to local economies.

More than 28 million people live within a half day drive of the Sequoia National Forest (USFS 2011). NVUM surveys reveal that residents of the Central Valley are the most frequent visitors to the Sequoia National Forest. Foreign visitation for the forest was higher than the region average in the surveys at 31 percent of all visitors surveyed in 2006 and 17.5 percent in 2011. Residents of southern California, Riverside, Los Angeles, San Diego, and Orange Counties, and the coastal communities also visit the Sequoia National Forest (USFS 2006, 2011).

Iconic landscapes on the Sequoia National Forest include the giant sequoia groves, Kings Canyon,, and the Kern and Kings Rivers. The Giant Sequoia National Monument covers approximately one third of the Sequoia National Forest and includes all of the giant sequoia groves within the forest boundary. The wide range of elevations, climate, vegetation, and topography offer visitors a diversity of land and water-based recreation settings for a vast spectrum of year around recreation opportunities. A designated system of roads and trails provide motorized, non-motorized, mechanized and equestrian access to recreation settings across the forest.

The most popular outdoor recreation activities on the Sequoia National Forest include fishing, relaxing, hiking/walking, viewing wildlife, driving for pleasure, viewing natural features, developed camping, picnicking, nature center activities and other non-motorized activity. Other activities listed in the NVUM surveys are nature study, viewing historic sites, bicycling, resort use, gathering forest products, non-motorized water activity, backpacking, primitive camping, downhill skiing, horseback riding, hunting, motorized trail activity, cross-country skiing, snow shoeing, snow play, rock climbing, and snowmobiling (USFS 2003, 2006, 2011).

A majority of visitors to the Sequoia National Forest prefer developed recreation sites. The forest currently offers 114 developed recreation sites, including 53 family campgrounds, 15 group campgrounds, 1 horse camp, 6 rental cabins, 14 trailheads, 7 boating sites, 11 picnic sites, 4 fishing sites, 1 information site,1 observation site, and 1 specialized sporting site. Of these sites, 42 are reported to remain open year round. Each facility attracts different social and cultural visitors based on miles to travel, amenities provided, and available space to recreate.   Therefore, traditions, ability to travel to a destination, available amenities, and access to water are all the factors to a satisfactory recreation visit and will influence demand for recreational experiences going forward.

Because Fresno, Tulare and Kern Counties are projected to have substantial growth in the next 20 years, the number of people participating in recreational activities may be expected to increase. However, factors such as economic conditions and gas prices can heavily influence growth rates and the number of people participating in recreational activities. These factors can lead to increases or decreases in growth rates and participation in recreational activities (California State Parks 2010).

The 2004 business plan for the Sequoia National Forest identified the following investment priorities for recreation: campground rehabilitation and reconstruction; and road, trail and trail bridge reconstruction (USFS 2004). From 1995 to 2003, forest expenditures rose considerably faster than inflation. Public use and enjoyment was funded at 72.5 percent of the required amount. Facility operations and management, including campgrounds and developed sites, concentrated use areas, trails and roads, were funded at 73.9 percent of the required funding. The funding gap is larger now, as appropriated funds have decreased since the business plan was developed. Expanding partnerships was identified as a strategy to help the Sequoia National Forest address operational shortfalls.

Climate change is evident, as the number of frost-free days is increasing (Cordell at al. 2009b, cited in the Monument Plan). Snowpack is expected to melt earlier in the season, particularly affecting where and when winter recreation activities occur in the future (Morris and Walls 2009). Activities dependent on snowmelt, such as whitewater boating on the Kern River, will also be affected.

For more detailed information on recreation as an ecosystem service see the August 2, 2013 snapshot of the Sequoia National Forest Living Assessment Chapter 7, lines 263-346.

Cultural Resources

More information on the current conditions and trends for cultural resources is found in Chapters 12 and 13 of this assessment.

The Sequoia National Forest provides the benefits of cultural and historic resources that expand the knowledge and understanding of history, maintain cultural and spiritual connections to our heritage, provide scientific data about past cultures and climatic conditions, and generate tourism in the area that benefits rural economies. The beneficiaries of these cultural and historic resources are Native American, European, Asian, and African American peoples located throughout the state and the country.

At least six federally recognized Native American tribes, plus more than 15 federally non-recognized tribes claim ancestral territory within or immediately adjacent to forest lands. Archaeological and linguistic evidence suggest some groups have been in place on the forest for at least 3,000 years. The known cultural resources on the forest are 60 percent prehistoric, 17 percent historic, 3 percent multiple component (i.e., contain both prehistoric and historic components), and 21 percent are unidentified. While most historic eras and events are documented, the location, extent, condition, and significance or many of the physical resources reflecting these episodes are unknown. The documentation available for known resources typically lacks data necessary to determine whether there is potential for impacts to occur prior to project-specific planning, including additional archaeological studies.

Of known cultural resources, few have been determined eligible or nominated for listing in the National Register of Historic Places.

Some of the drivers that affect cultural resources are as diverse as the resource itself. Activities and natural processes that are documented to have impacted cultural resources on the forest include but are not limited to the following:

- Climate change
- Recreational use

- Looting, vandalism, and illicit artifact collection
- Unauthorized marijuana cultivation

For more detailed information on cultural resources as an ecosystem service see the August 2, 2013 snapshot of the Sequoia National Forest Living Assessment Chapter 7, lines 347-414.

Biodiversity

More information on the current conditions and trends for biodiversity can be found in Chapter 1 of this assessment.

Biodiversity provides benefit to people as described in the Convention on Biodiversity co-authored by the Forest Service (Thompson et al. 2009, p.7):

> The best available scientific evidence strongly supports the conclusion that the capacity of forests to resist change, or to recover from disturbance, is dependent on biodiversity at multiple scales.

In addition, biodiversity also provides some direct service to people through the value that can be placed on meeting an ethical obligation to protect other species from extinction, supporting religious and cultural values associated with cherishing the Earth and its inhabitants, and the desire to leave for future generations that which we are able to enjoy (EPA 1999).

The Sequoia National Forest encompasses a broad range of habitats and elevations, ranging from blue oak woodland at 1,000 feet, to alpine fell fields at over 12,000 feet. Six major biotic provinces converge on the Sequoia National Forest and Giant Sequoia National Monument. Floristically, the High Sierra Nevada, Central Valley, Sierra Nevada Foothill, Southern California Mountains, Great Basin Desert, and Mojave Desert all overlap here (Miles and Goudey 1997). The southern Sierra Nevada is a giant floristic melting pot between the Central Valley and the Mojave Desert and also between the High Sequoia and the southern California Mountains. This confluence of diverse floras creates a high density of rare endemic plants and many unique plant communities.

Within the Southern Sequoia Province, fire occurred frequently within the mixed-conifer forests. Since fire is a natural part of the Southern Sequoia ecosystem, one of the most significant changes during the past century has been fire suppression management (Miller et al. 2009). The accumulation of live and dead fuels has increased to high levels in parts of the forest, possibly greater than the historic range of variability.

Climate change is a key landscape stressor affecting long term ecological conditions. It is expected that air temperatures and precipitation patterns may change across the Sierra National Forest over time. Modeling specific to California predicted that the recent increased fire activity would persist and intensify due to increased growth of fuels under higher CO_2 combined with low fuel moistures from longer and warmer summer temperatures, and possibly increased thunder cell activity (Meyer and Safford 2010).

The influx of non-native species of animals and plants since the first Europeans arrived in California has changed the ecosystems of the Sierra Nevada and this continues to be a major and increasingly important stressor on the Sequoia National Forest.

For more detailed information on biodiversity as an ecosystem service, see the August 2, 2013 snapshot of the Sequoia National Forest Living Assessment Chapter 7, lines 415-513.

The continued enjoyment of the benefits obtained from forest ecosystem services is vulnerable to the threat of uncharacteristic fire. Wildfires are becoming larger, more frequent and of greater severity and these fires are threatening the health of the resources in the forests that support ecosystem services. Any resulting interruption or loss of these services has a cost as these ecosystem services provide benefits both locally to forest users and rural communities, as well as regionally in the form of the water, energy, carbon sequestration, and cultural services provided to people all over the state.

To get a sense of the extent to which fire threatens the many important services that are provided by the Sequoia National Forest, the important landscapes that provide these services were examined in terms of their risk for uncharacteristic fire that would be detrimental to these services. It is clear that a high percentage of these important landscapes are under a threat from uncharacteristic fire. Specifically:

- 79 percent of the land with the most valuable assets for protecting water quality is at risk for uncharacteristic fire
- 80 percent of the land with the most valuable assets for supporting water supply is at risk for uncharacteristic fire
- 86 percent of the important timber producing land is at risk for uncharacteristic fire
- 87 percent of the important carbon sequestration land is at risk for uncharacteristic fire
- 32 percent of Forest Service recreation facilities are at risk for uncharacteristic fire
- 92 percent of the locations that provide habitat for important ethno-botanical species for cultural heritage uses are at risk for uncharacteristic fire
- 71 percent of the land important to providing terrestrial biodiversity is at risk for uncharacteristic fire
- 82 percent of the land important to providing aquatic biodiversity is at risk for uncharacteristic fire

The fact that so much of the forest's landscape that is important in providing these key services is at risk suggests that trends will be for increased loss and interruptions in the benefits that these services provide. Contributing to this potential trend in declining benefits to people is the fact that the cost of fire management and suppression have made up a larger and larger portion of forest budgets. With limited budgetary resources available for management, this increase in fire spending reduces the ability of the forest to take care of other management needs that also threaten the sustainability of these services. More details on the effect of fire on ecosystem services across the bio-region and the methods used in this analysis are available in the Bio-Regional Living Assessment Chapter 7.

Contributions the Plan Area Makes to Ecological, Social or Economic Sustainability

This section examines the stability and resiliency of key ecosystem services on the Sequoia National Forest and the influences outside of the forest.

Water

Results of the recent Watershed Condition Classification for the Sequoia National Forest found 16 watersheds functioning properly, 37 watersheds "functioning at risk" and two "impaired" functioning watersheds. There is one water body on the forest listed as impaired under the Clean Water Act, Lake Isabella.

Recreational visitation is a factor. Recreational water use patterns have changed drastically since the 1970s when average daily design flows were created in the Forest Service Handbook (Snodgrass 2007). More people now camp in recreational vehicles and trailers than in tents. Most recreational vehicles and trailers are almost twice as big as they were in the 1970s, and almost all now contain bathrooms. From the Snodgrass analysis, water rights covered by the Sequoia National Forest provide enough water for foreseeable future use for non-consumptive purposes.

For more detailed information on the contribution of water to sustainability see the August 2, 2013 snapshot of the Sequoia National Forest Living Assessment Chapter 7, lines 648-671.

Timber

There are over 20,000 acres of plantations on the Sequoia National Forest in need of treatment that would allow the stands to develop old forest conditions. The treatments are needed to reduce fuel loading, reduce inter-tree competition, and improve the species mix within the stands. While these plantations contain some saw log size material, the majority of the trees are only suited for biomass. There are few projects that provide adequate volume to potential markets to make the projects commercially viable.

The ability of the timber industry to respond to probable increased timber volume opportunity and production varies depending on milling infrastructure, logging infrastructure, and product transportation. The milling infrastructure available is currently underutilized and may be subject to failure under current government timber production plans. If it survives in the short term, available mills have the capacity to double and possibly triple output if the supply is made available.

For more detailed information on the contribution of timber to sustainability see the August 2, 2013 snapshot of the Sequoia National Forest Living Assessment Chapter 7, lines 672-710.

Carbon

Climate change that affects the growth of vegetation will impact the amount of carbon stored in the forest. Much of the carbon now accumulating in these forests is being added in the form of ladder fuels, which carry fire from the lower vegetation canopy to the upper canopy of trees. As mean fire size and burn severity has increased with vegetation changes, fire has come to play an increasingly important role in carbon storage (North 2013). Grazing also influences the carbon storage of ecosystems through forage removal, hoof action and activity that effects soil and livestock waste. Insect and disease outbreaks can convert forests from carbon sinks to sources (Kurz et al. 2008, Pfeifer et al. 2011). Finally, predicted increases in the population of California will have an influence on carbon storage and sequestration in the assessment area.

The 2006 Global Warming Solutions Act (CA Assembly Bill AB 32) requires California to reduce greenhouse gas emissions to 1990 levels by 2020, and to identify the most feasible and cost effective methods to reduce emissions. The reductions may be achieved through a variety of methods, including capping greenhouse emitting sectors and issuing emissions allowances that will achieve these greenhouse gas reductions.

For more detailed information on the contribution of carbon sequestration to sustainability see the August 2, 2013 snapshot of the Sequoia National Forest Living Assessment Chapter 7, lines 711-737.

Recreation

Visits to the bio-region for all types of recreating experience, including sight-seeing, camping, hiking, hunting, fishing, motorized activities and adventure sports play a key role in stimulating local employment by providing opportunities and goods and services for these recreation activities. Communities benefit economically from these visitors who spend money in hotels, restaurants, resorts, and gift shops and also contribute to sales tax revenues. As a result, this travel and tourism sustains local economies for communities near these abundant recreational areas.

Declining federal budgets have the potential to result in a declining quality of condition for existing facilities, resulting in a lower quality of experience. Budget limitations also hinder the ability of the Forest Service to expand recreation in response to people looking for more and different types of opportunities. Partnerships are critical to being able to sustain and expand recreation opportunities.

The Yosemite, Kings Canyon and Sequoia National Parks also provide high quality scenery and recreation opportunities outside the forest boundary as do county, city and state parks. So while the Sequoia National Forest does contribute to travel and tourism in the area, there are other recreational opportunities in the area that also drive this tourism, such as the national parks, and therefore this economic opportunity cannot be attributed only to visitors to the Sequoia National Forest.

For more detailed information on the contribution of recreation to sustainability see the August 2, 2013 snapshot of the Sequoia National Forest Living Assessment Chapter 7, lines 738-758.

Cultural Resources

It is difficult to identify future stability and resiliency of cultural resources. Cultural resources are inherently non-renewable and extremely fragile. Drivers can cause unforeseen and catastrophic consequences to cultural resources that may not be apparent for years, if not decades. For example, in this time of increasing wildfire threat, current management direction to avoid cultural resources during fuels treatment and timber removal activities has led to some unexpected adverse results. The Sequoia National Forest, in an effort to avoid impacting cultural resources, has excluded archaeological sites from fuels and vegetation treatments for approximately 30 years. Many prehistoric sites on the Sequoia National Forest, particularly on the Kern River District, contain sensitive Native American painted rock art panels. These ethnographic and archaeological resources are vulnerable and likely to be completely destroyed from exposure to high intensity wildfire. As a result, this unnaturally dense vegetation growth on archaeological sites on the forest could contribute to a catastrophic loss of a class of cultural resource sites valuable for archaeological study, Native American ethnographic value, as well as interpretive value for heritage tourism opportunities. High intensity wildfire can also completely consume all flammable wood materials on vulnerable historic sites with standing structures and significant wooden features. This policy of protection has allowed vegetation to grow unchecked on the sites, while the surrounding area has been treated, thereby concentrating fuels on these cultural resources and increasing the risk of catastrophic loss of the resource.

The Sequoia National Forest remains committed to cultivating good relationships with Native American tribes and Native American groups. National Forest System (NFS) lands and resources represent significant cultural and economic values to Native Americans. Forest Supervisors have the responsibility to maintain a government-to-government relationship with federally-recognized Indian tribes. They are to ensure that forest programs and activities honor Indian treaty rights and executive orders, and fulfill trust responsibilities, as those responsibilities apply to NFS lands. Treaties, statutes, and executive orders often reserve off-reservation rights and address traditional interests relative to the use of federal lands.

For detailed information on the contribution of cultural resources to sustainability see the August 2, 2013 snapshot of the Sequoia National Forest Living Assessment Chapter 7, lines 759-787.

Biodiversity

Timber harvest and management decisions have affected the current conditions of wildlife habitats. These cumulative factors, combined with nearly a century of fire suppression, have contributed to reducing overall landscape-level ecosystem heterogeneity and to some extent wildlife habitat diversity. Limitations to mechanical forest restoration activities during recent decades have contributed to the reduction of meadow and black oak habitat as a result of high tree density and encroachment. Overall, this loss of vegetation heterogeneity can detrimentally affect wildlife habitat diversity, as well as reduce ecosystem resilience to environmental stressors, such as climate change, severe wildfires, drought, disease and pest infestations.

Information Gaps

Key information gaps for ecosystem services exist surrounding the value of these services. It will be important to identify ways to prioritize the benefits to people from these services so that tradeoffs, both short term and long term, can be evaluated, compared and contrasted.

Ecosystem services are the benefits that people obtain from ecosystems and therefore these services have a value to everyone. Because these values are often difficult to quantify, impacts on these services can be neglected during forest planning. The term “value“ is used here to represent something more inclusive than a monetary or dollar value, but rather to capture the idea that benefits, even when they are not directly relatable to dollars spent or received, contribute to improving the quality of people’s lives. Examples of these types of non-monetary benefits are provided by key ecosystem services such as cultural heritage and biodiversity. In contrast, examples of key services that are tied to existing markets and therefore can be more directly related to monetary value are some aspects of recreation, timber and water.

As a result of this mix of monetary and non-monetary benefits, estimating a value of the ecosystem services provided by a forest can be a complicated endeavor and must be approached on a case-by-case basis. Potential benefits will differ depending on the service being examined, the location of that service and the users of that service. For example, the same service may be provided in two locations but in one location there are few users and many alternative sources of that service, and in the other there are many users and no easy alternatives. In addition, an effort to calculate a value can be resource intensive and require considerable time and money to accomplish. Therefore, complete values for the key ecosystem services of the Sequoia National Forest are not presented. However, it is possible to understand the potential value of these key ecosystem services by looking at the extent of the benefits they provide.

For more detailed information on the value of these ecosystem services see the August 2, 2013 snapshot of the Sequoia National Forest Living Assessment Chapter 7, lines 803-926.

Chapter 8: Multiple Uses–Water

Issues related to water quality and quantity run off regime have been covered in Chapters 1 and 2 and will not be repeated here. The beneficial uses of key watersheds and water rights were not addressed. Watersheds of the Sequoia National Forest drain into the Tulare Buena Vista Lakes Hydrologic Province and contribute to benefits such as municipal, commercial and agricultural uses, recreation, fisheries, groundwater recharge and fresh water replenishment of inland lakes and streams of varying salinity. See Chapter 10 for more information on hydropower and its delivery to municipal commercial and agricultural uses beyond forest boundaries. See Chapter 9 for more information on recreational water uses. See Chapter 8 – Fish, Plants, and Wildlife, for more information on the use of water related to fisheries.

As of 2012, 550 water rights uses that the Sequoia National Forest holds have been inventoried.

See Chapters 7 and 10 of this assessment for more information on hydropower and other benefits to people.

For more detailed information on trends, see the August 2, 2013 snapshot of the Sequoia National Forest Living Assessment Chapter 8, Water, lines 10-47.

Chapter 8: Multiple Uses–Fish, Plants and Wildlife

The Sequoia National Forest encompasses approximately 1,185,000 acres of land and waters. Most of that area is inhabited by plants, fish and wildlife, either seasonally or year-round. Approximately 1,800 plant species and hundreds of fish and wildlife species are found on the Sequoia National Forest. The presence of a variety of vegetation, wildlife and aquatic species, in ecosystems that are visited by the public, provides many opportunities for passive recreation such as nature watching, as well as active and direct connections through fishing and hunting.

Important Information Evaluated in this Phase

Multiple-use management of forest resources contributes a range of public benefits through ecosystem services (36 CFR 219.6(b)). These ecosystem services yield both tangible (e.g. timber, range, recreation) and less tangible (e.g. spiritual, cultural, air and water quality) benefits. The multiple-use mandate under the Multiple-Use Sustained-Yield Act of 1960 (MUSYA) (16 U.S.C. 528-531) and the National Forest Management Act of 1976 (NFMA) (16 U.S.C. 1600 et seq.) is not exclusive to a single resource or use, and the sustained-yield principle applies to all multiple-use purposes for which the national forests are administered.

Each of these multiple uses is assessed by defining the species or resources, current conditions and landscape level drivers that affect those resources. Condition trends are provided when available. The scope of these assessments is commensurate with the degree of multiple use benefits to the Sequoia National Forest plan area. The multiple uses of these resources on the forest include:

- Fishing

- Hunting
- Wildlife
- Plant Gathering

Nature, Extent and Role of Existing Conditions and Future Trends

Fishing

The forest provides reservoir fisheries, high mountain lake fisheries, and both warm and cold water fisheries. Streams and lakes above 3,000 feet elevation are generally considered “cold water” (water temperatures less than 70°F) fisheries, where anglers may catch rainbow, brown, or eastern brook trout and at very high elevation within wilderness the threatened little Kern golden trout. Elevations less than 2,500 feet are generally part of the pike minnow-hardhead-sucker assemblage described by Moyle (2002) as occurring within Sierra Nevada foothill streams. Water temperatures within this transitional area may exceed 70 degrees Fahrenheit during the summer, especially during “dry and critically dry” water years. Reservoir fisheries exist where dams established as part of hydroelectric power development. Forest waters less than 2,500 feet in elevation are considered “transitional” or “warm water” fisheries and are more likely to be occupied by fish from the bass, sunfish and catfish families, such as in Isabella Reservoir, along with occasional brown or rainbow trout at other sites below 3,000 feet. Angler experience and success may be affected by the time of year, since stream and lake levels may be influenced by spring runoff of snowmelt and low summer and fall flows, drought or drawdown of hydroelectric reservoirs in the fall.

Existing conditions of habitat and fisheries has been influenced by a variety of drivers. Among the findings from the Sierra Nevada Ecosystem Project (SNEP 1996) was that the aquatic/riparian systems were the most altered and impaired habitats of the Sierra Nevada.

This finding was based on:

- Effects to stream flow (through dams and diversions altering stream flow patterns and water temperatures);
- Loss of connectivity for lower elevation natives such as hard head minnows.
- Effects to riparian areas damaged by grazing and locally by dams, ditches, flumes, pipelines, roads, past timber harvest, and recreational activities;
- Excessive sediment yield into streams remained a widespread water quality problem in the Sierra Nevada due to cattle grazing and other activities;
- Water quality impacts (increased temperatures where riparian vegetation is lacking or where deep pools are lacking) and increased salinity in reservoirs when low through flow occurs (summer and drought years).

Introduced aquatic species have greatly altered aquatic ecosystems through impacts on native fish, amphibians, and invertebrate assemblages. Anadromous fish such as the native steelhead, once native to the Kings River, are now nearly extinct from rivers in the Sierra Nevada. Dams and impoundments, which block fish access to streams, together with degraded conditions above dams, have led to loss of about 90 percent of the historic habitat in the Sierra Nevada. Local degradation of habitats has led to significant impacts on aquatic invertebrates, which make up the vast majority of aquatic species in the Sierra Nevada. Impacts to invertebrates have significant cascading effects on the food chain, carbon pathways, and energy pathways in the aquatic ecosystem.

Hunting

Wildlife hunting is one of many social and economic uses provided to the public by Sequoia National Forest. The Forest Service is responsible for managing wildlife habitats on national forest lands whereas individual species are managed by California Department of Fish and Wildlife (CDFW). This assessment focuses on the most common hunted species on the Sequoia National Forest, given the limits of existing information availability. California blacktail deer, black bear, tree squirrel, wild turkey, mountain quail and California quail are the most popular game species on the Sequoia National Forest (CDFW 2012). Some of these species migrate outside of the forest boundary into the adjacent national parks, such as sub-populations of migratory deer. Species such as wild pig, quail, and wild turkey are most common in the lower foothills below national forest boundaries, but also are common in some lower elevation foothill areas of the forest. Annual permit data and hunter success is collected by CDFW for most hunted species (CDFW 2012). However, this data is collected by hunting unit boundaries defined by CDFW, not by individual national forest.

Currently, there are no detailed population estimates for hunted species on the Sequoia National Forest other than for California blacktail deer. Yea-round and seasonal California blacktail deer inhabitants of the Sequoia National Forest are primarily part of the Greenhorn, Breckenridge, Scodie, Piute and Kern River herds. In 2002, populations were estimated at approximately 3,500 animals with current populations predicted to be similar on the Sequoia National Forest (Anderson 2012). California blacktail deer of the Sequoia National Forest generate some of the highest rates of hunter participation, as well as the highest total expenditures for any individually hunted species (CDFG 2012, Duane 1996).

Trend assessments have been developed for the Kern River deer herd population based on unpublished data collected by CDFW (formerly CDFG) and local forest biologists from 1949 to 2002 (Anderson 2012). Historically, the population has been as high as 11,000 in 1949 and as low as 2,500 in 1989. A slight increasing trend in population numbers occurred in the late 1990s with an estimate of approximately 3,500 animals.

Many cumulative factors have strongly influenced the amount of seral habitat over the past 100 years of management, and current conditions of those habitats may be lower than levels within the natural range of variability. Creating and maintaining a sustainable level of early seral forage habitats, such as shrubs, forbs, and grasses, integrated with cover habitat, is essential for sustaining deer, as well as hundreds of other species that rely on early seral habitat conditions. The potential trend of California blacktail deer on the Sequoia National Forest is probably influenced by a multitude of factors. At a minimum, management considerations should consider maintaining early seral habitat, of shrubs, forbs and grasses within the historical range of variability.

For more detailed information on hunting see the August 2, 2013 snapshot of the Sequoia National Forest Living Assessment Chapter 8, Fish, Plants and Wildlife, lines 110-212.

Wildlife

For more detailed information on wildlife see the August 2, 2013 snapshot of the Sequoia National Forest Living Assessment Chapter 8, Fish, Plants and Wildlife, lines 222-270.

Plant Gathering

Plant gathering is an important aspect of multiple uses on the Sequoia National Forest and the Giant Sequoia National Monument. Plant gathering falls into two distinct categories, general public and tribal use.

Among the general public, bracken fern is an important resource on the Sequoia National Forest, particularly among the Hmong residents in the Central Valley. Plants important to tribes are various shrubs, herbs and graminoids used for basketry, cordage, and shelters including: willows, Indian hemp, milkweed, sourberry, sedges, deergrass, redbud, and dogwood; nut-producing trees such as California black oak, and beaked hazelnut ; berry producing shrubs and herbs such as elderberry, strawberry and blueberry; edible geophytes including snake lily, mariposa lily, and camas; and plants for medicinal or ceremonial uses such as wild tobacco, among many others (Anderson 1994, 1999, 2005).

There are a number of key ecosystem and management drivers that expected to affect the trend of the above listed plants. A primary mechanism by which fire contributes to the maintenance of culturally important plant species is by limiting the encroachment of competing species. Many plant species that are used by Native Californians as food, material, and medicine depend on fire both for persistence and for maintenance of desired growth forms and quality. Continued fire suppression, particularly when coupled with little or no prescribed burning, poses a threat to the sustainable production of these plants in the quantity and quality desired by Native Americans to sustain traditional life ways and livelihoods. In the absence of fire or forest thinning, many of these species will decline in abundance and mature to a condition where the plant material is not suitable for traditional cultural uses. An important research gap is to understand how moderate to high severity burns may have promoted or curtailed desired resources now and in the past, particularly as such burns become larger and less patchy.

Fire exclusion, and lack of forest thinning, can lead to encroachment by trees and forest into meadows and shrubs, hence converting to forest lands. These encroaching plants alter light and water availability and ultimately displace culturally important species. For example, beargrass is an important plant in the understory of conifer forests in Northern California, where it has declined in abundance in part due to fire exclusion (Shebitz et al. 2009, Charnley and Hummel 2011). A fire return interval of less than 20 years may be necessary to limit encroachment and maintain desired reproduction and growth of beargrass (Shebitz et al. 2008).

Contributions the Plan Area Makes to Ecological, Social or Economic Sustainability

Nationally, fish and wildlife-related recreation is clearly an important leisure activity with more than 90.1 million Americans, 16 years of age and older, participating in 2011 (USDI – USFWS 2006). An average of nearly four out of ten people participates in some type of wildlife recreation.

Fish and wildlife recreation is an important leisure activity and a catalyst for economic growth. Hunters, anglers and wildlife watchers spent $145 billion on wildlife-related recreation in 2011. This spending contributed to local economies throughout the country, which added to employment, raised economic output, and generated tax revenue. Such activity provides jobs and income to communities, helps maintain social cultures, maintains long standing traditions, connects people to the land, and contributes to the quality of life for many Americans and tribal nations.

Fishing

Nationally, there were 11,600,000 visits to National Forests in 2011 attributed primarily to angling (USFS 2011). Recreational fishing is also popular across California. During 2006, an estimated 1.7 million anglers spent a projected $2.4 billion associated with fishing in California, which supports jobs in local communities. Of these total anglers, approximately 1.2 million were associated with freshwater angling, spending an estimated $1.1 billion (USDI-USFWS 2006). With a variety of streams, reservoirs, and high elevation lakes, fishing is a popular recreational activity on the Sequoia National Forest.

Hunting

From 2003 to 2008, the Forest Service's National Visitor Use Monitoring (NVUM) program reported an annual 14.4 million visits to National Forest System (NFS) lands for the primary purpose of hunting (Mockrin et al. 2012). Total expenditures from these visits totaled almost $1.2 billion for hunting. Annually from 2000-2003, hunters expended nearly $50 million in or within 50 miles of national forests in California. These expenditures are the equivalent of 714 full and part time jobs and 3.7 million in federal tax revenues. Expenditures are substantially greater when considering all trip-related and equipment purchases within California attributed to USFS wildlife recreation (American Sportfishing Association 2007). Hunters annually spent $4.2 billion from 2000-2003 for Forest Service hunting activities, supported 97,000 jobs and generated $505 million in federal income tax revenues.

Nature Viewing and Plant Gathering

Nature viewing and plant gathering provides economic and social benefits. Communities benefit economically from these visitors who spend money in hotels, restaurants and shops during their visits. As a result, travel and tourism contributes to local economies supporting local jobs and earnings. Chapter 6 of this assessment provides information on the importance of visitor spending to the local economies surrounding the Sequoia National Forest.

Plant species have important uses related to cultural heritage and use. Ethnobotany studies have identified a number of these important cultural species that provide medicinal, food and hunting benefits to Native American tribes in California (Reid et. al 2009, Anderson 1996). These types of benefits may be difficult to value monetarily, but are critical in sustaining and improving the quality of life for those users.

Information Gaps

Systematic inventories to document the population trends of several deer herds and other hunted species on the Sequoia National Forest do not exist. Current distribution and population estimates of hunted species are generally based on anecdotal accounts and historical records from state and federal biologists. In addition, CDFW does not report hunter success by forest. It only reports by hunting unit boundaries (zones), therefore it is difficult to determine the number of hunted species taken in any given year inside the forest boundary.

Chapter 8: Multiple Uses-Range

Important Information Evaluated in this Phase

The range program is described by information related to levels of livestock grazing and the condition of these rangelands. This section provides information on the animal unit months (AUMs) grazed, number of cattle and permits and the allotments on the Sequoia National Forest. Rangeland condition is described for meadows, riparian and wetland areas and annual grasslands.

Nature, Extent and Role of Existing Conditions and Future Trends

Livestock Grazing

Records for the Sequoia National Forest for 2012 show 7,703 head of cattle (mature cow with nursing calf) were permitted to graze at various times throughout the year with the primary grazing season of April 1 through September 30 each year. A total of 51,496 animal unit months (AUMs) were authorized to graze under a term grazing permit. Another 11,717 AUMs were authorized to graze in association with private lands intermingled with one allotment under an on/off provision within one of the term grazing permits. Within the planning area, 43 permittees are authorized to graze livestock on 51 allotments.

Summary of current livestock numbers grazing on the Sequoia National Forest

	Total numbers on term permits	Total numbers on on/off permits	Total numbers on term private land permits	Total
Total permitted number of cattle	7,517	76	110	7,703
Total permitted AUM of cattle	51,496	11,717	1,145	64,358
Total permitted head months of cattle	39,257	8,996	868	49,121
Total permitted number of horses (on cattle permits)	9	0	0	9

Head month is one month’s use and occupancy of range by one weaned or adult animal, bull, steer, heifer, horse, burro, mule or five sheep or goats.

The planning area is primarily in Kern and Tulare Counties, with half of the Hume Lake Ranger District in Fresno County. Livestock numbers found within the counties that overlap and extend beyond the planning area were examined on the broader landscape for grazing activity. The total number of beef cattle across Kern and Tulare Counties is 971,000 (Tulare and Kern 2011 County Crop Reports). The total permitted number of cattle grazed on the Sequoia National Forest is 7,703 or 0.79 percent of the two county totals.

For more detailed information regarding the historical and current livestock use see the August 2, 2013 snapshot of the Sequoia National Forest Living Assessment Chapter 8, Range, lines 27-58.

Rangeland Condition

In 1999, the Forest Service initiated a long term meadow condition and trend monitoring program for the national forests in California. Two primary methods were used to sample key sites for condition: 1) rooted frequency of plant species in quadrat frames in riparian areas; and 2) riparian green line sampling along streambanks (Winward 2000, McInnis and McIver 2009). These methods were selected to evaluate condition (also termed ecological status) of range types on key areas.

The primary purpose of the program was to 1) document baseline meadow conditions as the Sierra Nevada Forest Plan riparian standards and guidelines were coming into use; and 2) examine long term trends in meadow condition following implementation of these riparian standard and guidelines. The program currently includes 618 permanent meadow vegetation monitoring sites established in key meadows. Vegetation composition is measured at time of site establishment and then every five years following. There are 496 plots within the ten Sierra Nevada Forest Amendment national forests, 57 of which are on the Sequoia National Forest. As of 2012, a total of 246 sites have been re-read over the past ten years, across 127 grazing allotments. During the period 2000-2012, authorized animal unit months on California national forests declined 27 percent (USDA Forest Service, Range Management Grazing Statistical Summary).

Annual grasslands and savannahs are among the most productive rangelands on the Sequoia National Forest. Forage production can be highly variable in relation to timing of fall rains and temperature. Site differences in canopy closure, slope, aspect, soil type and average rainfall significantly affect production as well. Forage production on sites typical of the planning area can vary site to site and year to year from 200 to over 3,000 pounds per acre.

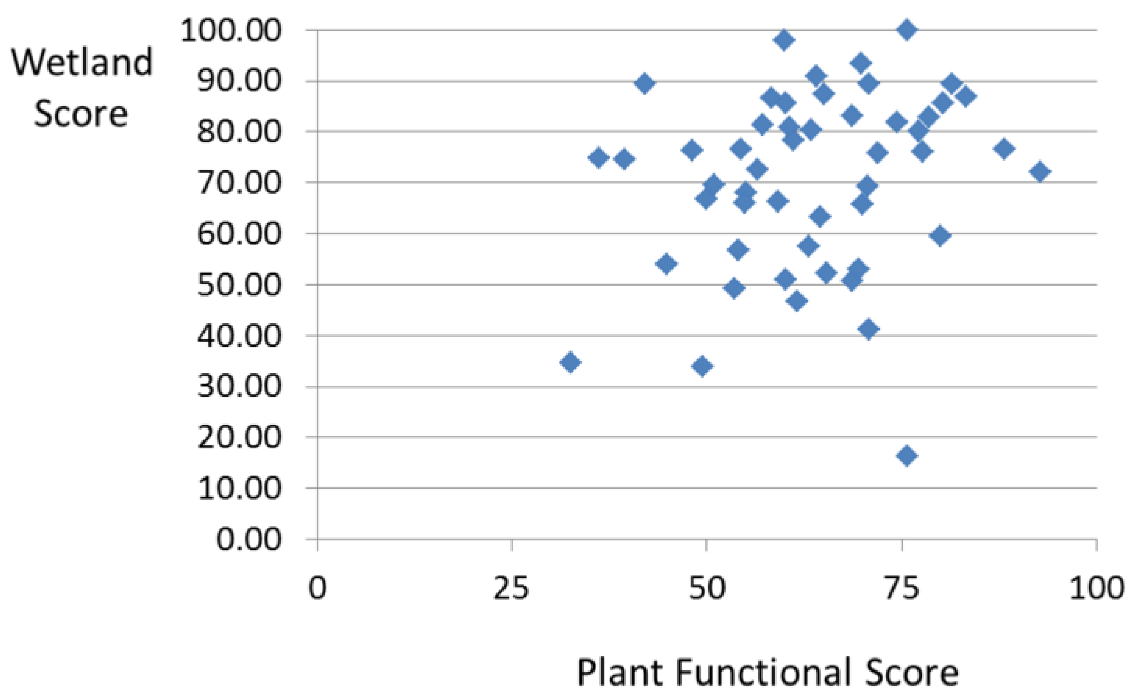
Meadows

Recent studies have emphasized the importance of meadow ecosystems as centers of biodiversity and links between terrestrial and aquatic systems. Meadow ecosystems are among the environments most disturbed by humans and need restoration to maintain biodiversity and ecological integrity. Meadow systems comprise less than 1 percent of the total area of the Sierra Nevada and Southern Cascade Ranges in California (Ratliff 1985, Sawyer et al. 2007). They are among the most species-rich vegetation types and are actively used for both recreation and livestock grazing (Fites-Kaufman et al. 2007). Meadows are defined as areas dominated by herbaceous vegetation and generally occur where there is shallow groundwater.

Vegetation changes occur as a result of many factors other than grazing, and disturbance is a natural feature of plant communities (Ruyle and Dyess 2010). Current studies are underway in cooperation with the University of California at Davis to analyze the effects of both grazing management and weather factors in determining meadow condition and trend. Grazing is not necessarily a primary driver of vegetation change and even when grazing has been the cause of vegetation change, current levels of grazing may be inconsequential. Even completely removing grazing will not always result in a return to historical conditions (Westoby et al. 1989). Some, perhaps many, altered plant communities can no longer achieve what may have once been a historic condition because of lack of a current seed source, the presence of highly competitive and sometimes exotic introduced plant species and changes in soil characteristics limiting species adaptation to the site . These situations are considered state changes in vegetation (Bestelmeyer et al. 2004, 2009, Briske et al. 2008). If current vegetation is a result of climate and disturbance to date, it may be unrealistic to expect vegetation to return to historical conditions, especially in the face of global climate change.

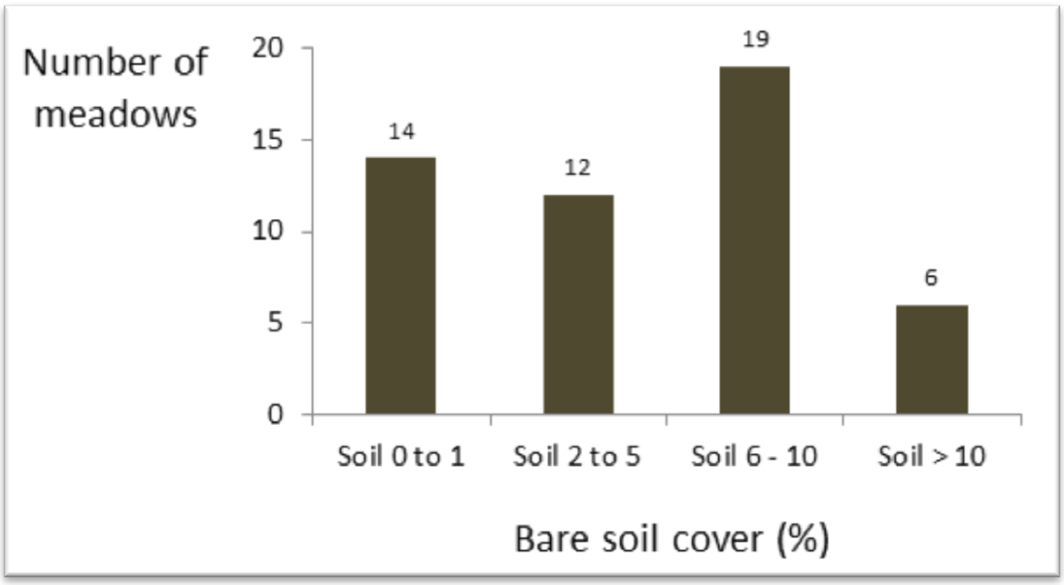
Meadow condition can be summarized in terms of the proportion of later successional plant species as compared to early successional plant species on a site (Weixelman and Gross, unpublished, to be submitted 2013). In addition, Weixelman and Zamudio (2001) devised an integrated measure of meadow ecological condition for meadows in the Sierra Nevada based on vegetation and soil factors. Meadow condition can be portrayed from sites dominated by early seral species and shallow root depths to those dominated by late successional species with deeper rooting depths. Four condition classes are described above: early seral, mid seral, late seral and potential natural vegetation (PNV). The four condition classes represent ecological health from low (early seral) to high (potential natural vegetation). At the early seral stage, there is a high amount of disturbance resulting in an abundance of early successional plant species, shallow root depths, and generally more bare soil. In late seral and PNV classes, late seral species are dominant, disturbance is low, rooting depths are deep, and there is very little bare soil. Mid seral stage is intermediate between early seral and late and PNV stages. Late seral and PNV condition classes represent a desirable condition because there are ample amounts of late successional plant species for community resilience, greater plant diversity than lower condition sites (Weixelman and Gross, unpublished, to be submitted 2013), and deep rooting depths to maintain soil stability and streambank protection.

The figure below shows the functional score for 51 key meadow sites in the Sequoia National Forest (from USFS R5 Long Term Monitoring Project data). The sites displayed represent the long term monitoring plots established at key sites from 1999 to 2004. These plots are revisited every five years. Conditions reflect the latest reading for each of these sites. The axes scores are from Gross et al. (in manuscript, to be submitted 2013). The condition or plant functional scores (National Research Council 1994) are 0-25 for early seral, 26-50 for mid seral, 51-75 for late seral, and more than 75 for potential natural vegetation (PNV). The wetland score on the y-axis indicates the abundance of wetland plant species, larger numbers corresponding with a higher proportion of wetland species.



Condition of Meadow Monitoring Sites

The graph below displays the percentage of bare soil cover found in the key meadow condition plots. Sites that are below 10 percent bare ground are generally in satisfactory condition in terms of soil stability. A bare ground cover of 10 percent or greater generally indicates significant meadow degradation. The average percent bare ground for meadow sites on the Sequoia National Forest was 6.5 percent. Over 90 percent of the meadow sites sampled indicate high protective ground cover since the data indicate less than 10 percent bare soil.



Bare soil cover

Riparian Condition – Proper Functioning Condition Assessments

Selected riparian-wetland areas within the planning area were inventoried and monitored to determine whether these areas are functioning properly based on a qualitative assessment of the vegetation, landform/soils, bank erosion, and hydrology to determine watershed, stream and riparian area function. This assessment indicated that the majority of the riparian areas were functioning properly. An assessment of the hydrologic function of meadow habitats and other special aquatic features during range management analysis have been inventoried and monitored for specific projects but has not been summarized across the planning area.

Livestock grazing has potential to adversely affect water quality. The Sequoia National Forest conducts annual monitoring of range best management practices (BMPs) to evaluate impacts to water quality and aquatic habitat. The forest has completed 30 evaluations of range allotments since 1992 using the Regional G24 protocol for BMP monitoring. Like all BMP protocols, G24 provides a method of determining whether the forest correctly implemented BMPs and whether these BMPs were effective in protecting water quality. Of the total of 30 evaluations, 28 were rated as both implemented and effective. The remaining two evaluations were rated as implemented at risk, meaning that although the BMPs were correctly implemented, minor departures from effectiveness were noted. Overall, these results indicate that range management on the Sequoia National Forest has provided good protection of water quality.

Additional details regarding riparian condition are available in the August 2, 2013 snapshot of the Sequoia National Forest Living Assessment Chapter 2, lines 367-401.

Summary of Annual Grassland Rangeland Condition

Annual grasslands and savannahs are among the most productive rangelands on the Sequoia National Forest. Forage production can be highly variable in relation to timing of fall rains and temperature. Site differences in canopy closure, slope, aspect, soil type and average rainfall significantly affect production as well. Forage production on sites typical of the planning area can vary site to site and year to year from 200 to over 3,000 pounds per acre.

Current management direction for livestock grazing within the planning area comes from several sources, which include the 1988 LRMP, 1990 Mediated Settlement Agreement (MSA), the 2004 Sierra Nevada Forest Plan Amendment, and the Giant Sequoia National Monument Plan. This direction is currently reflected in the terms and conditions of each term grazing permit within the plan area.

The guidelines used to manage livestock use on annual grass range are based on retention of differing levels of residual dry matter (RDM) or mulch and percent ground cover. Residual dry matter provides favorable microenvironments for early seedling growth, soil protection, adequate soil organic matter and a source for low moisture fall forage for livestock and wildlife. RDM can be measured utilizing different methods depending on the observed pattern of use.

Management of rangeland use on the Sequoia National Forest is based on the key area management concept. The key area management concept is based on the premise that evaluation of correctly identified small areas is a reliable guide to grazing management in the unit or allotment. A key area is defined as a sample area selected to be indicative of forage utilization on a unit or allotment. In size, the key area may vary from a comparatively small part of the primary range to practically all of the primary range. Each grazing season, forage utilization is measured for the specific area in each allotment. When RDM measurements are determined, at the end of the grazing season, to be within the specified use requirement (manage for 700 pounds per acre RDM), the range is considered to be in satisfactory condition. The results of the measurements are discussed with each respective permittee and documented in the annual rangeland implementation monitoring report. A summary of forage utilization monitoring for the 2002 through 2011 grazing seasons are shown below. The table summarizes all forage utilization monitoring, which includes monitoring of annual grass and montane meadow systems. As shown in the table, the percent of allotments monitored within compliance rose steadily from 91 percent in 2002 to 100 percent in 2011.

Since 2006, seven range National Environmental Policy Act (NEPA) decisions have been completed within the planning area and include analysis of 30 individual allotments. All of the range NEPA completed thus far has been primarily in annual grass/oak woodland systems.

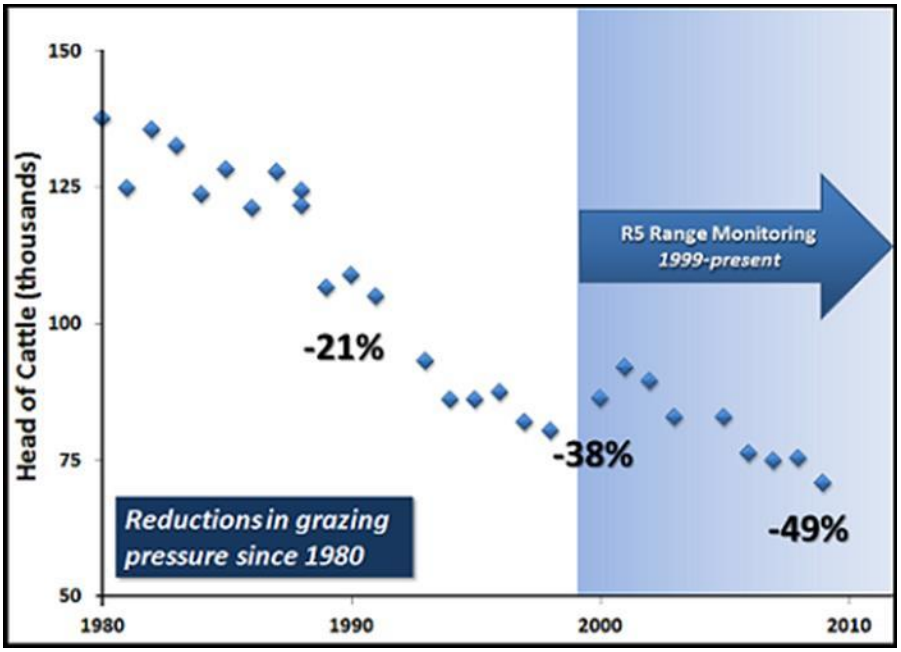
A recurring issue requiring mitigation, through allotment analysis, was the need to improve the riparian component of many riparian areas, primarily springs and relatively small portions of streams within annual grass systems. As a result of analyzing range condition through the NEPA process, eight allotments required riparian area fence protection totaling 24 specific riparian areas. All of the sites required fencing to reduce livestock impacts and move the area to an acceptable standard. Sixteen of the sites have been constructed and the remaining seven are pending. NEPA was completed in September 2011 for 8 sites, one of which was completed in 2012. Four additional riparian exclosures were constructed on Greenhorn Mountain to address resource concerns. All of the sites fenced thus far have shown improvement and upward trend in the riparian component of the sites.

Utilization monitoring in montane meadows consists of determining the percent of forage removed or utilized by weight, and is calculated as a percent use. In annual grasslands, the amount of forage left after the grazing period is calculated as residual dry matter in pounds per acre. Specific grazing standards and guidelines, including allowable use utilization standards and guidelines are outlined in the Sequoia National Forest LRMP, as amended.

Utilization monitoring within the planning area between 2002 and 2011

Year	Total Key Areas	Total Key Areas Monitored	Total Non-Key Areas Monitored	% of Key Areas Monitored	% Total Monitored within Standard	% Total Monitored not within Standard	Allotments Monitored within Compliance	Allotments Monitored not within Compliance	% Allotments Monitored within Compliance
2002	211	131	24	62	60	5	50	5	91
2003	291	221	57	76	87	11	82	6	93
2004	191	132	26	69	88	10	49	5	91
2005	191	123	24	64	95	5	50	2	96
2006	189	101	20	54	105	7	46	0	100
2007	189	101	20	54	105	7	46	0	100
2008	191	84	23	44	84	8	33	1	97
2009	197	100	21	51	87	6	35	1	97
2010									
2011	198	96	19	49	84	2	35	0	100

Trends Influencing the Condition of Rangelands and Transitory Range



Trend in head of cattle on Forest Service grazing allotments in California

This figure represents trend in head of cattle on Forest Service grazing allotments in California from 1980 through 2010 grazing. Reductions in number of head relative to 1980 numbers were 21, 38, and 49 percent in 1990, 2000, and 2010, respectively. The long term meadow condition and trend monitoring program was initiated in 1998.

A preliminary assessment is in progress between the Forest Service and the University of California Davis to estimate trends in meadow conditions over the last 20 years. The study is described below under Information Gaps.

Contributions the Plan Area Makes to Ecological, Social or Economic Sustainability

Livestock grazing is likely to be sustained within the planning area over the next 20 years based on recent past site-specific range analyses. Projects have been successful in improving livestock management. Additionally, the emphasis of ecological restoration at the watershed scale will contribute to the direct and indirect sustainability of grazing on the Sequoia National Forest.

Meadow restoration is a priority on the Sequoia National Forest. This restoration will sustain and improve the main elevation forage base. The forest uses bio-engineering to stabilize degraded riparian areas to reduce stream bank erosion, improve and restore overall hydrologic function, and remove encroaching conifers.

Livestock use has occurred since the late 1800s and is one of a variety of multiple uses on the Sequoia National Forest that contributes to the economic and social wellbeing of people. It provides opportunities for economic diversity. It promotes stability for communities that depend on range resources for their livelihood. It meets the public needs for interrelated resource uses by providing livestock forage, wildlife food and habitat, outdoor recreation and other resource values dependent on range vegetation.

The administration of the grazing program on the Sequoia National Forest is intertwined with conservation of California rangeland, primarily in the foothills adjacent to the forest. This is due to an eligibility requirement of Forest Service grazing permits for permittees to own base property ranches when they are not using the forest's rangelands. Properly managed rangeland conserves important ecosystem services including the delivery of fresh water and habitat for native plants and wildlife. Many rural communities continue to be dependent on ranching for their economic livelihood and are located in some of California's fastest-growing communities. The rate of development for non-agricultural uses of California's rangelands exceeds the land conversion rate for forests and croplands combined, and this trend is expected to continue (Wetzel et al. 2012).

Economic sustainability of these ranches owned by permittees over the next 20 years is the most difficult to predict. Their future will depend on the ability to maintain a viable and profitable livestock operation based on the availability of a sustainable forage base. Ranchers are already faced with the need to manage for diverse goals and have been encouraged to produce products with a higher market value, such as organic and natural meats. In most cases, it is the herd size authorized in the Forest Service grazing permit that limits the ability of many permittees to rely on ranch income alone. Each permit has a certain capacity, resulting in a set number of permitted livestock that the range can support for the season of authorized use. Many permittees have already diversified their operation to supplement their income from part-time to full-time off-ranch work.

In order to cope with reductions of National Forest System (NFS) lands for summer grazing, ranchers favor leasing more private land. However, these lands are in short supply and there is strict competition for the leases. This information is summarized in a 2002 University of California Berkeley report to the Sierra Nevada Alliance, California Cattlemen's NFS lands attributed 40 to 50 percent of their income to their access to summer grazing lands. Those interviewed who graze on NFS land said they have no desire to sell their ranches, but a third stated that they would have to consider selling if they lost their Forest Service grazing permit. The majority of ranchers surveyed responded that living and working amidst natural beauty was a highly important reason to continue ranching and that although ranching is not seen as the ideal way to make a living, most ranchers want their children to continue ranching and to pass on the family tradition (Sulak and Huntsinger 2002).

Information Gaps

In 2012, the Forest Service and the University of California Davis Rangeland Watershed Laboratory established a partnership to conduct the first comprehensive analysis of the Long Term Monitoring Program dataset. Researchers and Forest Service rangeland specialists are currently in the process of examining these data to determine: 1) meadow conditions and trends; and 2) relationships between meadow conditions and trends, livestock management, weather and environmental drivers. When the information is available, it will be used to inform the analysis supporting plan revision as applicable. This study will represent the most scientifically updated assessment of trend and response to grazing management, as well as to weather and other factors on national forest meadow and riparian rangelands.

Meadow health will be assessed using the rooted frequency (Bonham 1989) data to calculate a suite of indicators of meadow condition and trend, including species richness, diversity (Simpson's and Shannon-

Wiener indices) and evenness. Soil stability scores (Burton et al. 2010,Winward 2000) will also be calculated from plant functional trait groups, which are based on life form, life span, plant height, growth form (clonal or not), and nitrogen fixing ability.

For information and current status of the study go to the University of California Davis rangeland watersheds website.

Preliminary analysis of long term monitoring sites on the Inyo National Forest are presented and discussed at the UCD Rangeland Watershed Laboratory website.

There are no current surveys of conifer encroachments in meadows.

Chapter 8: Multiple Uses–Timber

Important Information Evaluated in This Phase

- Introduction of how timber harvest and production can play an important role in attaining desired conditions for ecological sustainability and can contribute to social and economic sustainability.
- Identify and evaluate how timber harvest and production contributes to social, economic, and ecological sustainability.

Nature, Extent and Role of Existing Conditions and Future Trends

Current Condition and Future Trends

Approximately 75,000 acres of productive forest land is available on the Sequoia National Forest. The productive and available forestland is currently classified as approximately 60 percent mixed conifer, 15 percent Jeffrey pine, ten percent red fir, five percent Ponderosa pine, and five percent lodgepole pine. This estimate excludes lands in the Giant Sequoia National Monument and other lands to account for limitations such as riparian, steep slopes, non-productive areas, forest legacy structures requiring protection for wildlife and ecological purposes, and lands that are not considered economically and physically treatable with mechanical logging systems.

The table below indicates that the average acre on the Sequoia National Forest on which restoration treatments may be performed is growing 266 board feet per acre per year. Mortality is removing 93 board feet per acre per year, for an average net gain of 173 board feet per acre per year. The general forest is consistently growing in volume, even as the forest harvests 4 MMbf each year. This harvest consists of mostly smaller understory growing stock, and part of the mortality occurring in hazardous areas near roads, campgrounds, special use facilities, and other area of common public use (Pacific Northwest Forest and Range Experiment Station, Westcore tables 2011).

Average acres on the Sequoia National Forest on which restoration treatments may be performed

Suitable Productive Forest Land (acres)	Annual Net Growth (MMbf)	Average Annual Mortality (MMbf)	Mortality as % of Net Growth %	Average Planned Annual Volume Sell (MMbf)	Average Volume Sell as % of Annual Growth %	Average Volume Sell as % of Annual Mortality %
75,000	20	7	35%	4	20%	55%

The Sequoia National Forest essentially abandoned even-aged reforestation management 20 years ago, in favor of stand maintenance thinning harvests intended to control density and growth of stands, generally for habitat maintenance. Thinning reduces the number of trees on a site, allowing remaining trees to increase crown and photosynthetic production, and increases growth rates on those remaining trees. Remaining trees grow larger and faster than untreated stands. This cannot continue forever naturally. Once maximum densities are achieved (usually planned for about 15 years), some of those larger trees must die or be removed to accommodate population growth. As with most living things, tree species have distinct maximum life spans, and there tends to develop a maximum average stand age.

In general, the forest composition is being converted to full tree occupancy. While large individual trees are more resistant to the effects of fire, maintaining full site occupancy in such trees puts the forest at risk from other mortality agents like insect damage.

Wildland Urban Interface Fuels Reduction and Forest Restoration Projects

Most timber sales on the Sequoia National Forest are based on restoration and fuels reduction needs. The Breckenridge and Rancheria projects are primarily needed to reduce the threat of fires to mountain communities within the forest boundary. In addition to community protection, removal of hazard trees from recreation and administrative sites and along public roads has been a significant source of timber removal.

There are over 20,000 acres of plantations on the Sequoia National Forest in need of treatment in order to allow the stands to develop old forest conditions. The treatments are needed to reduce fuel loading, reduce inter tree competition, and improve the species mix within the stands. While these plantations contain some saw log sized material, the majority of the trees are only suited for biomass. There are currently few projects that provide adequate volume close enough to potential markets to make the projects commercially viable.

For additional information see the August 2, 2013 snapshot of the Sequoia National Forest Living Assessment Chapter 8: Timber, lines 57-98.

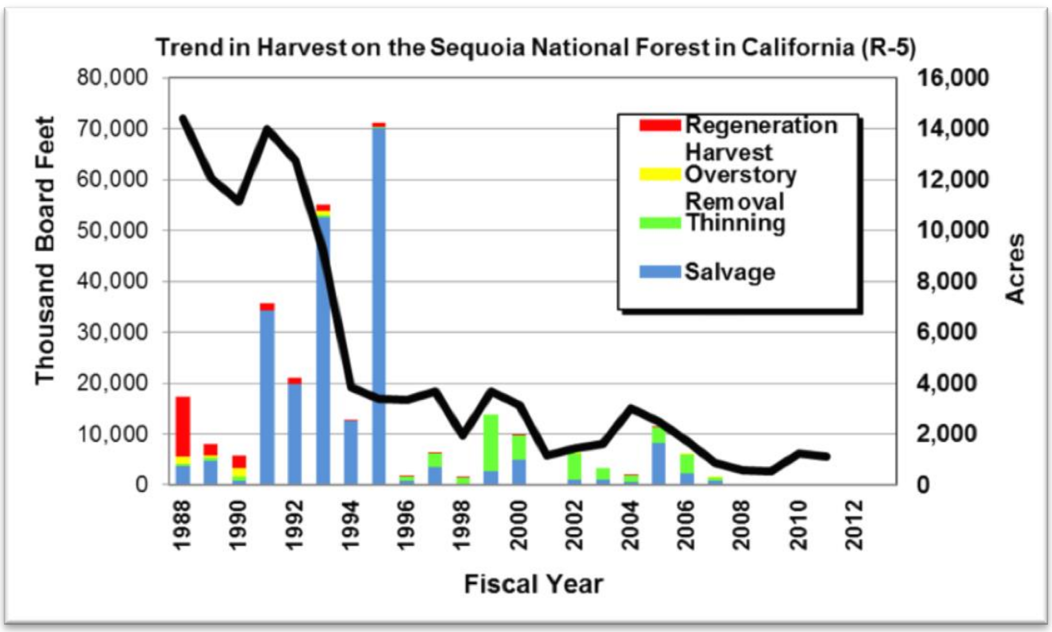
Current Levels of Timber Harvest and Production in the Plan Area and Within the Broader Landscape

The five year (2008-2012) average timber volume sold from the Sequoia National Forest is 3,800 Mbf. Annually, the timber harvest from the Sequoia National Forest comes from approximately two to three thinning projects, one public safety hazard removal project, and projects removing trees from special use permit areas.

The Sequoia National Forest is providing timber for three remaining sawmills: Sierra Forest Products in Terra Bella, California, and Sierra Pacific Industries in Chinese Camp, California and Standard, California. The Sierra Forest Products mill is the last remaining in California south of Yosemite. Sierra Forest Products also operates a wood-fired electrical power plant co-located with its mill.

Timber under contract from the Sequoia National Forest has been declining over the last 25 years. Volume under contract was severely depleted in the boom years of the late 1980s. It recovered somewhat in the early 1990s, and then declined mostly in response to the requirements of the Sierra Nevada Forest Plan Amendment (SNFPA) of 2001 and 2004.

This figure shows the Sequoia National Forest timber harvest shift from management for resource production to management for ecological function.



Trend in Harvest from the Sequoia National Forest

The Ability of Timber Harvest to Affect Forest Resilience to Stressors such as Fire, Insects, and Disease

Climate Change

Projected future temperatures appear to continue the warming trend, while projections for precipitation are even more uncertain. In the short term, management practices that result in lower tree densities may provide for increased resilience, as well established research indicates that lower stocking levels result in reduced tree mortality.

Reestablishing forests, after either stand replacement wildfires or purposeful regeneration harvests, with seedlings from selected seed sources may also provide for some level of resilience in the longer term. Establishing conifer genotypes from lower elevations or more southerly latitudes may provide for an adaptive advantage when facing a warming climate.

Wildfire

An analysis of the Sequoia National Forest for the years 2000 to 2011 indicates wildfire occurred on 338,334 acres, including 160,217 acres of productive forest. On these 160,217 acres, wildfires resulted in nearly complete tree mortality on 85,284 acres. This is approximately 19.3 percent of the total available productive forest on the Sequoia National Forest (USDA Forest Service 2004, Miller and Safford 2008).

Insects and Disease

The Sequoia National Forest has experienced significant mortality of white fir due to high stand densities and over stocked stands. While the mixed conifer vegetation type is only a portion of the landscape on the forest, these stands require significant management attention. Their location, midslope on the Sierra Nevada Mountain, and the current condition of the species composition, fuel loading, tree age and size, differs dramatically with the historical condition. The trend to rapidly grow to overstocked conditions due to the relative recent historical stand development of modern accretions of young shade tolerant less fire-resistant tree species (white fir and incense cedar) puts them at risk for both fire and insect and disease mortality elements.

Current Capacity and Trend for Logging and Restoration Services and Infrastructure for Processing Wood within the Broader Landscape

The ability of the timber industry to respond to increased timber volume opportunity and production varies with milling infrastructure, logging infrastructure, and product transportation. Transportation may adjust quickly depending on general economic and market alignment. Difficulties in the recovery of this sector involve high capital costs of equipment acquisition, operation, and maintenance, adequate workforce recruitment and training, and improved operating season to support high value employees and their families.

Recently, log transportation costs have increased 20 percent. Traditionally, trucking costs have fluctuated with the cost of fuel and labor costs. Part of the recent increase may be a temporary effect of the modernization of the local truck fleet as it updates equipment to new California state standards. Viable trucks are in short supply.

Contributions the Plan Area Makes to Ecological, Social or Economic Sustainability

Ability of Timber Harvest to Maintain or Restore Key Ecosystem Characteristics Identified in the Assessment of Ecological Sustainability

Vegetation management through restoration required to maintain forest habitat under the anticipated environmental stresses described in Chapter 3 of this assessment is critical to respond to increased mortality from drought, fire, insects, and disease. Forest capital resources, both human and financial will be stretched.

Even-age silvicultural stand management tools for timber production were largely replaced by interim thinning entries, gradually evolving towards all-age silvicultural methods, for habitat conservation and development. Heavy harvests for regeneration purposes produced larger more valuable logs which funded transportation access and reforestation. The retention of timber receipts in trust funds for reforestation and other resource enhancement use provided for plantation creation in the 1990s and tending, as well as low canopy fuel reductions in natural stands.

Thinning produces many smaller less valuable logs, reducing the ability of timber extraction to fund other concerns beyond road maintenance. Trust funds contracted and there was less need for planting, but the need for plantation tending and a need for understory small tree reduction for fuels management and stocking control was identified. Since 2000, there has been a general shift from plantation creation and stocking control funded by timber generated trust funds, toward natural stand understory thinning and fuels reduction funded increasingly by appropriated tax funding.

Contribution of Timber Harvest and Production in the Plan Area for Ecological, Social, and Economic Sustainability

Timber requirements are addressed in the 2012 Planning Rule at 36CFR219.11. Plan components must ensure that no timber harvest for the purpose of timber production may occur on lands not suitable for timber production, timber harvest would occur only where soil, slope or other watershed conditions would not be irreversibly damaged, would be carried out in a manner consistent with the protection of soil, watershed, fish, wildlife, recreation and aesthetic resources, and contains direction on the maximum size of openings allowed. The 2012 Rule at 219.11(d)(6) as amended on April 19, 2013 states the: “quantity of timber that may be sold from the national forest is limited to an amount equal to or less than that which can be removed from such forest annually in perpetuity on a sustained yield basis.” Scheduling of regulated timber harvest and its associated allowable sale quantity (ASQ) will be addressed as part of forest plan revisions and will be addressed in the National Environmental Policy Act (NEPA) analysis phase of the upcoming Sequoia National Forest plan revision effort including the calculation of an updated long term sustained yield.

Maintenance of business infrastructure to support Forest Service restoration goals is a critical concern for the Sequoia National Forest, the tribes, other agencies and public utilities. Markets for excess or hazardous timber help defray the costs of required maintenance for facilities, roads, and fuels management. The business infrastructures most dependent on vegetation and timber management are lumber milling and logging entities. Log transportation is also required. They are related and integrated, but must grapple with similar but separate issues.

Information Gaps

The yield tables commonly used to determine desired stocking levels were generally developed in the late 1920s and early 1930s (Meyer, Dunning and Reineke, Schumacher) when vegetation had been growing under cooler and wetter conditions than are currently being experienced. Use of these stocking guides should be adjusted for warmer, drier conditions possibly leading to decreased site productivity (reduced stocking and growth potential).

The land base should be evaluated for acreage and growth reductions expected from large catastrophic wildfire anticipated through the next planning period (15 years). Loss of land base, inventory, and potential growth has major implications on the ability of the Sequoia National Forest to produce planned sell volumes.

Chapter 9: Recreation Settings, Opportunities and Access, and Scenic Character

Important Information Evaluated in This Phase.

Existing, relevant information about recreation settings, opportunities, access, and scenic character of the plan area were identified and evaluated. Factors outside the plan area that may influence the demand for recreation in the plan area or the ability of the plan area to meet those demands were also evaluated. Finally, this information was used to discuss the sustainability of recreation in the plan area. This information largely comes from the August 2, 2013 snapshot of the Sequoia National Forest Living Assessment Chapter 9. See lines 1763-1949 for more specific information on existing information sources. Additional information also comes from the draft Sierra Nevada Bio-Regional Assessment.

Nature, Extent and Role of Existing Conditions and Future Trends

Recreational Settings

Recreation settings are the social, managerial, and physical attributes of a place that, when combined, provide a distinct set of recreation opportunities. The Forest Service uses the Recreation Opportunity Spectrum (ROS) to define recreation settings and categorize them into six distinct classes: primitive, semi-primitive non-motorized, semi-primitive motorized, roaded natural, rural, and urban (36 CFR 219.19). For ROS class definitions, see the August 2, 2013 snapshot of the Sequoia National Forest Living Assessment Chapter 9, lines 111-141.

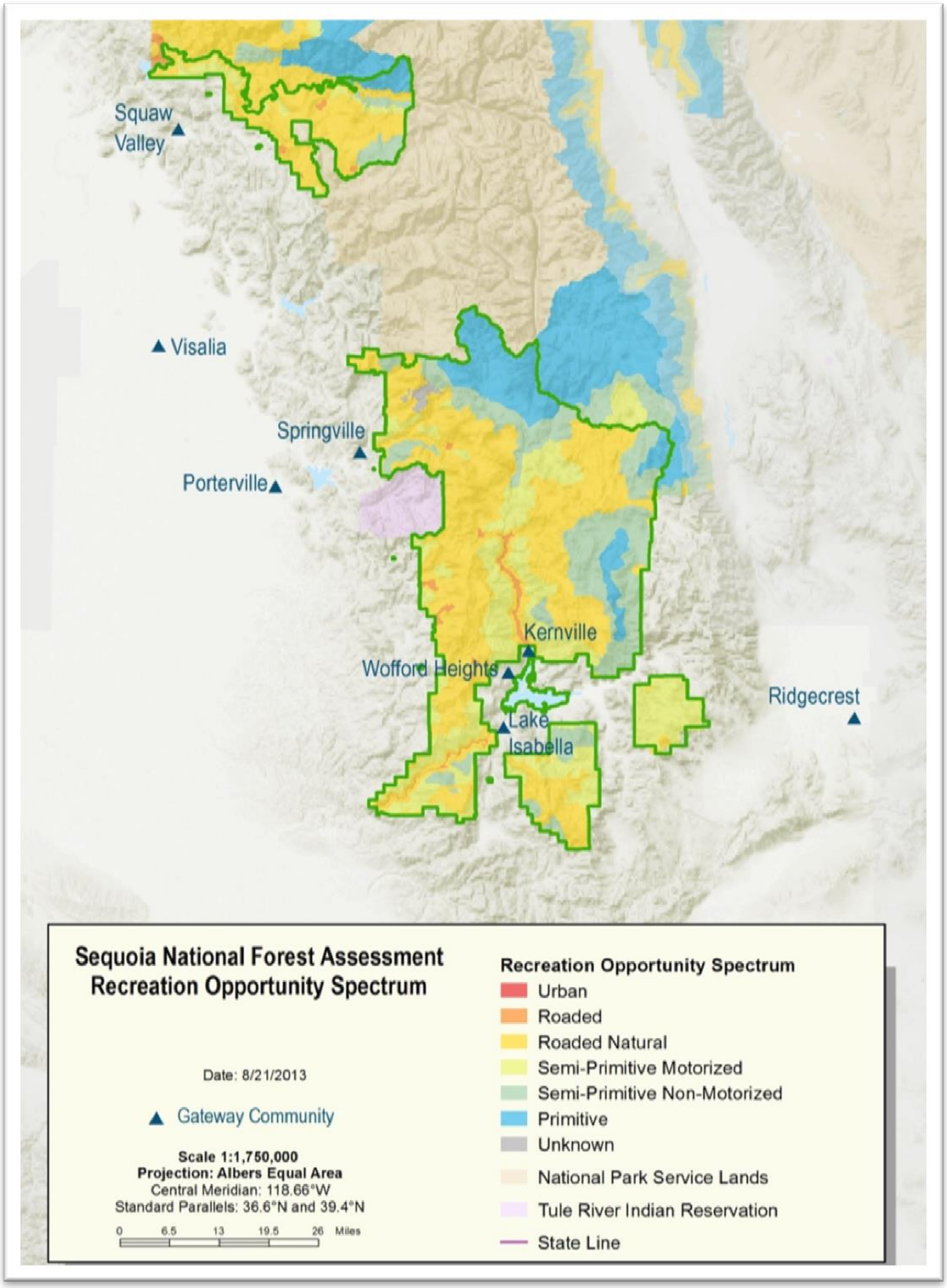
The ROS system was developed to support the planning direction under the 1982 Planning Rule. ROS classes for the Sequoia National Forest were originally established under the 1988 Land and Resource Management Plan (LRMP), which was then revised in the 1990 Settlement Agreement and amended by the 2012 Monument Plan.

ROS classes on the Sequoia National Forest

ROS Class	Acres	% Total Acres
Primitive	106,931	9.8
Semi-primitive non-motorized	202,863	18.5
Semi-primitive motorized	244,090	22.3
Roaded natural	527,340	48.1
Rural	10,916	1.0%
Urban	0	0.0%
No assigned class	3,916	0.4%
TOTAL	1,096,056	100.0%

Outdated ROS classifications currently exist as a result of changes in management and land status since the 1988 LRMP. One example is the land around Lake Isabella, which was transferred from the Army Corps of Engineers to the Forest Service in 1991. Another example is the designation of the Kiavah Wilderness, which includes areas previously classified as semi-primitive motorized.

Starting in 2007, Recreation Facility Analyses (RFAs) were conducted nation-wide to address growing concern about the agency's ability to maintain recreation sites to meet the needs of the public. In 2008, the Sequoia National Forest completed its RFA and a five year program of work to align management of recreation sites and facilities with the forest's niche and economic capability. Since 2007, national forest recreation programs throughout the country have been guided by program niche statements and complementary niche settings developed through the RFA process. Niche statements broadly define the scope of a national forest's recreation program and highlight those aspects that are distinctive.



Sequoia National Forest Recreation Opportunity Spectrum

The following is the niche statement for the Sequoia National Forest (USFS 2008c):

> *The Sequoia National Forest, named for the world's largest trees, celebrates the greatest concentration of giant sequoia groves in the world. The Sequoia's landscape is as spectacular as its trees. Soaring granite monoliths, glacier-carved canyons, caves, roaring world-class whitewater, and scenic lakes and reservoirs await your discovery at the Sierra Nevada's southern reach. Elevations range from 1,000 feet in the lower canyons to peaks over 12,000 feet on the crest of the Sierra, providing visitors with spectacular views in a dramatic range of settings. These mountains stand in contrast to California's San Joaquin Valley, providing cool relief for families from the scorching heat of summer and welcome blue skies and sun during the cold fog of winter. These spectacular features provide an attractive overnight destination for visitors from far and near.*

As shown in the table below, the Sequoia National Forest has thirteen niche settings, which represent the geographic areas that provide a contiguous backdrop for particular opportunities and activities. Places within these niche settings represent specific geographic locations that the public can identify with through commonly shared images and perceptions. ROS classes described above are considered a finer-scale subdivision of these niche settings; however, niche settings from the RFA process have not yet been integrated with the ROS classification system. Niche settings for the entire forest have not yet been mapped.

Niche settings and places on the Sequoia National Forest

Niche Setting	Places
Rivers and Lakes	Kern River
	Tule River
	Kings River
	Lake Isabella
	Hume Lake
Hume High Elevation	Hume High Elevation, Kings Canyon Scenic Byway
Great Western Divide	Great Western Divide, Western Divide Highway
Lloyd Meadow	Lloyd Meadow
Kern Plateau	Kern Plateau, Sherman Pass Road
Greenhorn	Greenhorn
Wildlands	Kiavah Wilderness
	Dome Lands Wilderness
	Monarch Wilderness and Agnew Roadless
	Jennie Lakes Wilderness
	KRSMA
	Golden Trout Wilderness
	South Sierra Wilderness
	Oat Mountain
Kings River Special Management Area (KRSMA)	Kings River, KRSMA, KRSMA (OHV)

Niche Setting	Places
KRSMA (OHV)	KRSMA (OHV)
Scenic Routes	Kings Canyon Scenic Byway, Western Divide Highway, Sherman Pass Road
Front Country	Front Country, KRSMA
Piutes	Piutes
Breckenridge	Breckenridge

Conditions and trends affecting recreation settings are further discussed by examining the components that contribute to recreation settings, including opportunities, access, and scenic character section.

Recreational Opportunities

A recreation opportunity is an opportunity to participate in a specific recreation activity in a particular recreation setting to enjoy desired recreation experiences and other benefits that accrue. Recreation opportunities include non-motorized, motorized, developed, and dispersed recreation on land, water, and in the air (36 CFR 219.19). The Sequoia National Forest manages for a set of outdoor recreation activities that is consistent with the forest's niche and ROS classifications. The opportunities may be provided by the Forest Service directly, or under a special use permit.

Non-Motorized Recreation

Non-motorized recreation opportunities are available across all ROS classes. Despite differences in recreation preferences across demographic groups, and changes that have occurred over time, the core set of activities preferred by the majority of people have generally been non-motorized activities like walking, picnicking, swimming, riding bicycles, and viewing and learning about nature (Cordell as cited in Hoyle 2009). These activities are some of the easiest and least expensive to provide, and address the needs of a broad group of people (Cordell as cited in Hoyle 2009). Non-motorized activities are popular on the forest and have maintained some of the highest participation rates according to National Visitor Use Monitoring (NVUM) data. Dispersed camping in concentrated use areas (CUAs) is especially popular on holiday and summer weekends. Non-motorized recreation activities are generally accessed using a personal motor vehicle to travel to a trailhead, developed campground, or forest location.

Motorized Recreation

Motorized recreation opportunities on the Sequoia National Forest are available in the semi-primitive motorized, roaded natural and rural ROS classes. Motorized recreation is prohibited by law in all designated wilderness. Motor vehicle use is restricted to designated routes that can include paved highways and roads, gravel or dirt Forest Service roads, and trails designated for motor vehicle travel. In the Giant Sequoia National Monument there is no motorized use on trails except within the Kings River Special Management Area, where off highway vehicle use is allowed. The forest provides 378 miles of trails and 681 miles of roads for motorized use. These trails and roads may be open to all motor vehicle use or restricted to specific vehicle classes. Many are seasonal or may be closed for resource protection under certain conditions. Many county and state roads within the forest are also open to street legal motor vehicles.

According to NVUM data, driving for pleasure is the most popular motorized activity on the Sequoia National Forest, with about a third or more visitors participating in this activity in 2006 and 2011. Motorized water sports follow driving for pleasure in popularity according to the NVUM data, though the opportunity is limited to Lake Isabella and is most popular during the summer. Off-highway vehicle use is another motorized activity on the forest that occurs in areas such as the Greenhorn Mountains, Piutes, and Kern Plateau. Off highway vehicle use is often associated with four-wheel drives, all-terrain vehicles, dirt bikes and other high clearance vehicles. These vehicles may be street legal or non-street legal requiring Green Sticker registration with the State of California. The State of California Off Highway Vehicle Program provides grant funds for facility maintenance and program management. Riding snowmobiles is a motorized winter activity that occurs at higher elevation depending on snow conditions and is heavily funded through partnership with the California State Parks Off Highway Motor Vehicle Recreation Division. About 134 miles of groomed routes are available.

Developed Recreation

The majority of visitors to the Sequoia National Forest prefer developed recreation sites. During the public involvement phases of the Recreation Facility Analyses (RFA), it became very clear that the public values developed sites. It was important to continue to make these developed sites available for public use. The table below shows the number and capacity of developed recreation sites on the forest, broken down by seasonality and ROS class. The contribution from the Monument is also displayed.

Developed recreation sites on the Sequoia National Forest

Site type	Time of Year Open		ROS Class			Total Sites	Capacity	Monument	
	All year	Seasonal	Semi-primitive non-motorized	Roaded natural	Rural			Total Sites	Capacity
Family Campground	18	36	1	32	21	54	12,194	21	2,806
Group Campground	8	7	0	7	8	15	1,225	7	565
Horse Campground	0	1	0	1	0	1	30	1	30
Cabins/lookout (Grouse Valley and Wishon cabins are not included)	3	3	0	6	0	6	48	3	23
Picnic Areas	7	4	0	4	7	11	806	5	306
Boating	7	0	0	0	7	7	1,378	0	0
Fishing	3	1	0	3	1	4	1,600	1	100
Trailhead	3	11	0	13	1	14	1,176	13	1,096
Specialized	1	0	0	1	0	1	500	0	0

Site type	Time of Year Open		ROS Class			Total Sites	Capacity	Monument	
Sports									
Observation	0	1	0	1	0	1	20	0	0
Information	0	1	0	1	0	1	35	1	35
Totals	50	65	1	69	45	115	19,012	52	4,961

There are no developed recreation facilities in designated wilderness or the primitive and semi-primitive non-motorized ROS classes. Facilities in developed recreation sites are provided for visitor comfort and convenience.

Dispersed Recreation

Dispersed recreation occurs throughout the forest with little or no facilities. Popular undeveloped sites are known as concentrated use areas (CUA) and are scattered across all ROS classes, typically near water bodies. When facilities are provided, they are for the purposes of resource protection. These areas typically provide rustic camping opportunities and are especially hard hit on holidays and weekends during the summer months.

See the August 2, 2013 snapshot of the Sequoia National Forest Living Assessment Chapter 9, lines 543 and 547-601 for more details on non-motorized, motorized, developed, and dispersed recreation opportunities.

Recreation in the Snow, Water, and Air

While winter recreation use on the forest is relatively low, available recreation activities include downhill and cross-country skiing, snow play, riding snowmobiles and snow shoeing. There is one small ski resort, Alta Sierra, at the top of Greenhorn Summit. The Montecito Lake Resort on Generals Highway in the Hume Lake District maintains an area for cross-country skiing and snow play. Popular locations for snow play and cross country skiing are Big Meadows on the Hume Lake District, Quaking Meadow on the Western Divide District, and the Greenhorn Mountains and Kern Plateau on the Kern River District. Developed winter trailheads are maintained at Quail Flat and Big Meadow on the Hume Lake District.

The rivers, lakes and reservoirs offer motorized and non-motorized boating, fishing, swimming, whitewater rafting and boating, windsurfing, and kayaking. There are three marinas on Lake Isabella, which is the only place on the forest offering motorized boating and which is popular for windsurfing. Boating on Lake Isabella is managed by Kern County, while lake access is managed by the Forest Service. Hume Lake is restricted to non-motorized boating. Whitewater outfitter guides provide rafting opportunities on the Kern River and Kings River. Private boating on the Kern River is managed though a permit system. Fishing opportunities are regulated by the California Department of Fish and Game and are mostly seasonal, although some sections of rivers and Lake Isabella are open for fishing year round.

Recreational use of private planes, ultra-lights, gliders, and hang gliders can be observed over the Sequoia National Forest. Lake Isabella is an authorized seaplane landing area. People have been landing on the lakeshore for recreation and business purposes since the 1940s. The Kern Valley Airport, located on 294 acres of the Sequoia National Forest next to the lake, has served the community and the public for more than 50 years. The airport facilities are owned and operated by Kern County under a special use permit. To date there are no existing or historic back country airstrips within the boundaries of the forest.

Important Recreation Sites or Areas

Based on niche rankings done in the RFA, areas of high importance include: Kern, Tule, and Kings Rivers; Lake Isabella; Hume Lake; Hume High Elevation, including Big Meadow and Converse Basin; Kings Canyon Scenic Byway; Great Western Divide and Western Divide Highways, Lloyd Meadow, Kern Plateau; and Sherman Pass Road.

Special Uses

Recreation special use permits allow for occupancy and use of the national forests. Permitted recreation uses provide opportunities to the public for services not offered by the Forest Service, and deliver economic benefits to rural economies. Some uses are commercial enterprises that offer services for a fee. They are operated by businesses, private entrepreneurs, non-profit groups, and semi-public agencies. Examples include outfitting and guiding, resorts, campgrounds, organizational camps, and private camps. Non-commercial recreation uses consist of sites or activities that do not serve the general public but are reserved for use by specific groups, such as clubs or by individuals and families. All special uses go through a screening and approval process, environmental analysis under National Environmental Policy Act (NEPA) procedures, and other required analysis before a permit may be issued. The Forest Service issues permits for the minimum time necessary to accommodate the use, ranging from a single day up to a maximum of 40 years.

The Sequoia National Forest currently manages 259 active special use authorizations. There are currently special use authorizations for: ten organization camps (nine in the Monument), 206 recreation residences (148 in the Monument), five resorts (three in the Monument), four marinas, two permits for concession campgrounds, 22 outfitting and guiding services, one winter recreation resort, one target range, one golf course, one cavern, five recreation events, and one non-commercial group use. A single permit can authorize use in multiple forest locations. Private businesses operate and maintain many developed recreation sites on the forest, including four day use sites, 30 developed family campgrounds, all group campsites except those at Camp 9, and four rental cabins.

For more detail on recreation special uses see the August 2, 2013 snapshot of the Sequoia National Forest Living Assessment Chapter 9, lines 647-678.

Conditions and Trends Affecting Recreation Opportunities

Public Preferences and Demand

Recreation opportunities are affected by recreational trends and the mix of outdoor activities chosen by the public, which continuously evolve (USFS 2012a). National Visitor Use Monitoring (NVUM) data provide information on visitor use and visitor satisfaction, which can create understanding about what types of activities people are interested in and the quality of their experiences. NVUM data are used throughout this document and provide the most relevant, reliable and accurate data available on visitation for the bio-region's national forests. NVUM data are collected using a random sampling method that yields statistically valid results at the forest level. As a rule, NVUM results are unbiased; the sampling plan takes into account both the spatial and seasonal spread of visitation patterns across the forest. However, results for any single year or season may under or over-represent some groups of visitors. Unusual weather patterns, major fire closures, or unanticipated pulses or lapses in visitation are not incorporated into the sampling framework. Because of the small sample size of site-days, or because some user groups decline to participate in the survey, it is possible to under-represent certain user groups, particularly for activities that are quite limited in where or when they occur. Results of the NVUM activity analysis do not identify the types of activities visitors would like to have offered on the national forests. It also does not tell us about displaced forest visitors who no longer visit the forest because the activities they desire are not offered.

The top ten most popular activities in terms of visitor participation on the Sequoia National Forest stayed relatively constant between 2004 and 2011, though rankings have changed over time. They include:

- Fishing
- Relaxing
- Hiking/Walking
- Viewing Wildlife
- Driving for Pleasure
- Viewing Natural Features
- Developed Camping
- Picnicking
- Nature Center Activities (in 2011)
- Other Non-Motorized
- Non-Motorized Water (in 2006)
- Motorized Water Activities (in 2004)

Relaxing, viewing wildlife, hiking and walking and driving for pleasure have consistently remained the top five most popular activities. Fishing had the highest percentage of participation (48.4 percent) in 2011. See the August 2, 2013 snapshot of the Sequoia National Forest Living Assessment Chapter 9, line 382 for the full list of visitor participation across activities. In addition, see lines 1094-1106 for a list of activities that currently occur on the forest and are expected to be primary activities over next decade. Nationally, increases in site-based activities, such as camping in developed sites and family gatherings, and in viewing and photographing nature occur (Cordell 2012, as cited in Winter et al. 2013).

The Sequoia National Forest is an overnight destination, rather than a day use destination (USFS 2008c). Overnight visitors typically choose to camp in developed sites rather than primitive sites. Because overnight visitors spend more time using recreation resources and require more support services such as restrooms, drinking water, and trash service, they require more Forest Service resources than day use visitors (Cole 1993). According to NVUM data, most of the recreation on the forest happens in the summer, and is especially heavy on holidays and weekends. Many visitors looking for relief from the summer heat are attracted to water bodies and cooler temperatures at higher elevations (USFS 2008a, b, c). During winter months, most of the higher elevation areas become inaccessible due to snow and road closures. Limited recreation activity occurs, shifting to snow-based activities or activities at lower elevations.

Overall visitor satisfaction on the Sequoia National Forest has decreased over the last several years. In 2006, 95 percent of visitors were very or somewhat satisfied with their visit, compared to 84 percent in 2011. In particular, the satisfaction rating for perception of safety declined. Satisfaction with developed facilities actually increased during this time period. Areas for potential improvement include restroom cleanliness and the availability of interpretation and recreation information. The public has higher expectations for quality, service, and convenience in their recreation experiences (APPL 2004, California State Parks 2005, Hill et al. 2009). Population growth, increasing demand for recreation opportunities, and changing demographics may impact the quality of experiences in the future.

Emerging or Unique Recreation

Californians use advances in technology and transportation to expand their outdoor experiences, allowing them to go further and faster than ever before (California State Parks 2005). In addition, the internet has increased access to information about recreation opportunities and has allowed people to virtually visit public lands (California State Parks 2005). Geo-caching is one example of a high-tech adventure game that is increasing in popularity and merges the internet with outdoor recreation (California State Parks 2005).

Compatibility Issues and User Conflict

Increasing population growth and demand for recreation opportunities may lead to more conflict among forest users. The variety of recreation activities that people are interested in is expected to continue to grow, potentially competing with existing uses (California State Parks 2005, Cordell 1999).

Crowding can affect how and when people visit an area (Cordell 1999). Some people do not mind crowds, and crowds can also positively influence recreation experiences. However, many people find that overcrowding adversely affects their recreation experiences. Consequently, they may avoid visiting areas and shift their visits to other places or times that are less crowded. If people perceive that areas are always crowded, they may simply avoid visiting them altogether (California State Parks 1998, 2002, 2003). The Sequoia National Forest experiences pockets of very intense use at certain sites and seasons. Summer use on weekends and holidays is extremely high in the Lake Isabella area, Lower Kern River, Tule River Canyon, Highway 99 along the Upper Kern River and Kings Canyon Scenic Byway.

Places of increasing public concern are water bodies and the Kern River, especially the Upper Kern River where overnight camping in concentrated use areas is negatively impacting resources. The open camping policy in the Upper Kern River corridor allows visitors to camp outside the six developed campgrounds, which has resulted in public health and safety concerns, as well as concerns related to protecting the outstandingly remarkable values for which the river was designated under the Wild and Scenic Rivers Act (USFS 2010). Issues cited in a 2012 letter from local residents and anglers to Forest Service officials include: trash along the river, camping too close to the river, illegal fire rings, human waste and toilet paper along river banks, illegal cutting of live trees and bushes, a lack of law enforcement, and illegal poaching of fish in protected areas.

Social, Cultural, and Economic Conditions

Based on 2011 NVUM data, the table below lists the distance travelled by visitors to the forest. Compared to 2006, visitors in 2011 lived closer to the Sequoia National Forest.

Distance travelled by visitors to the forest

Distance travelled from home	Percent total visits to the Sequoia National Forest
0 - 25 miles	29.9
26 - 50 miles	12.7
51 - 75 miles	11.8
76 - 100 miles	8.6
101 - 200 miles	18.3
201 - 500 miles	11.7
Over 500 miles	7.0
Total	100.0

Residents of Central Valley counties, particularly Kern County followed by Tulare and Fresno Counties, are the most frequent visitors to the Sequoia National Forest. Residents of Riverside, Los Angeles, San Diego, and Orange Counties also contribute a substantial amount to forest visitation. Land managers have observed that visitor use patterns vary tremendously from the north and the south sections of the forest. More people from the San Francisco Bay area and international visitors tend to visit the northern Hume Lake District. People from the Los Angeles basin visit the forest's southern sections, especially Kern Canyon, Lake Isabella, and the Kern Plateau.

Many international visitors are attracted by the giant sequoia groves and the two national parks adjacent to the Sequoia National Forest. Recreation is a prime lure for attracting visitors from overseas, and it is a growing factor in travel and residency patterns (California State Parks 2002, Hill et al. 2009). Based on 2011 NVUM, an estimated 2.3 percent of visitors came from foreign countries, down from 8.2 percent in 2006. Multi-national forest users have different expectations for their recreation experiences than those of the traditional forest user, and also provide a challenge in effective communications (Cordell 1999).

Future changes in the state's population will affect outdoor recreation more than anything else. More than 28 million people live within a half day drive of the Sequoia National Forest, and over 2 million people live within an hour's drive from the forest (USFS 2012b). Across the counties that contribute to the Sierra Nevada bio-region, population growth is expected to be greatest in Fresno, Kern, and Tulare Counties, which surround the Sequoia National Forest. By 2050, the population in this three county region is expected to increase by over 90 percent compared to 2010 levels (Lin and Metcalfe 2013). Much of the rapid growth is expected in Central Valley communities, outside the Sierra Nevada. However, the Central Valley has smaller state parks with fewer amenities to serve growing populations and lacks well-developed regional parks systems similar to other areas (California State Parks 2008). This growth is expected to increase demand for recreation opportunities on the Sequoia National Forest.

Economic conditions can heavily influence growth rates and participation in recreational activities. Household income can affect participation, particularly in activities with high cost recreation equipment (California State Parks 2009, Cordell 1999). Economic recession or prosperity also affects participation patterns, as equipment sales, travel distance, travel frequency, and activity choices can all be affected by the amount of disposable income available (Cordell et al. 2009). Gasoline costs may have negative or positive effects on forest visitation; some people visit as a closer-to-home travel option than what they would normally choose, while others choose not to visit or visit less often. Gas prices also affect the activities that people choose. According to NVUM data, annual visitation has decreased from an estimate of 640,000 people in 2006 to 626,000 in 2011, which may reflect the economic recession. In addition, there were fewer foreign visitors and an increase in local visitors, as mentioned above. The number of people at the lower end of the income scale is increasing disproportionately as the state's population grows. People with lower income rely more on public recreation facilities (California State Parks 2009). The three counties surrounding the Sequoia National Forest have the greatest percentage of households below the poverty level and the greatest percentage of households depending on cash public assistance and food stamps in the Sierra Nevada bio-region (Lin and Metcalfe 2013). About 50 percent of visitors in 2011 reported a household income under $50,000, which is up from about 30 percent in 2006.

No demographic trend is of greater importance to national forest managers and leaders than the immense growth of cultural diversity in the state (Roberts et al. 2009). Shifting demographics are expected to change recreation demands on national forests and may impact visitor satisfaction. The prominence of Latino and Asian values and vision is expected to increase as these two cultural groups increase in size and influence (Roberts et al. 2009). For example, research indicates that many ethnically diverse groups prefer more developed sites that have picnic tables, grills, trash cans, and flush toilets (Roberts et al. 2009). Group facilities for both camping and day use are important to Hispanic visitors and will become even more so in the future as larger groups of family and friends want to recreate together (California State Parks 2003, 2005).

What constitutes a family has changed over the years because of changing demographics. Where, in the past, a family was viewed as a mother, father, and their children, today a family may be multi-generational and may or may not be related by blood or marriage (California State Parks 2005). While there is more racial and ethnic diversity in the southern Sierra region surrounding the Sequoia National Forest compared to the rest of the Sierra Nevada bio-region (Lin and Metcalfe 2013), people from culturally diverse backgrounds are still under-represented as forest visitors. Forest management can create barriers to use and enjoyment (e.g. language and lack of information) by the growing population of ethnic minorities in California and the United States as a whole (Roberts et al. 2009). A vast majority of forest visitors are White (93.7 percent in 2011 and 91.8 percent in 2006) and non-Hispanic (12.9 percent in 2011 and 14.6 percent in 2006).

See the August 2, 2013 snapshot of the Sequoia National Forest Living Assessment Chapter 6, lines 535-561 for more details on ethnic and racial demographics in the area.

The Sequoia National Forest is a very family-oriented forest. Children under the age of 16 accounted for more than 20 percent of visitors in 2011 (29 percent in 2006), and adults over the age of 60 accounted for about 19 percent of visitors in 2011 (8 percent in 2006). As the baby boom generation ages the proportion of the population that is elderly will increase. Baby boomers and older adults want more amenities and improved access, while younger adults want more immediate and lively information and access, drawn by opportunities for excitement, such as extreme sports and adventure recreation (California State Parks 2005). People expect instantaneous information, thanks to the internet, so that they can customize their recreation experiences, as well as have virtual experiences (APPL 2004, California State Parks 2005, Cordell 1999, USFS 2008c).

Environmental Conditions

Climate change is predicted to produce warmer temperatures and drier conditions influencing snowpack, drought, and hydrologic flow. As the number of frost-free days is increasing (Cordell et al. 2009) less precipitation will fall in the form of snow, particularly affecting where and when winter recreation activities occur in the future (Morris and Walls 2009). The snowpack is expected to melt earlier in the season, producing less runoff to feed rivers and streams during the summer months. Activities dependent on snow melt, such as whitewater boating on the Kern River, would be affected. Warmer and drier conditions will threaten fisheries and the availability of adequate settings for other water-based activities in drought cycles. Warmer temperatures could cause recreationists to shift their activities to higher elevations during the summer months to escape the heat. Increased frequency of large, severe fires or areas with high insect or disease tree mortality that reduces the attractiveness of the recreation setting or renders it unsafe for visitor use could reduce the availability of desirable settings for the outdoor activities that visitors want to pursue.

Other Recreation Opportunities on the Broader Landscape

The availability of recreation opportunities on other lands within the broader landscape can impact recreation on the Sequoia National Forest. Sequoia and Kings Canyon National Parks has camping opportunities, which fill to capacity and overflow into the Hume Lake District of the Sequoia National Forest during the summer. Some national park visitors prefer the national forest camping facilities and use these facilities while visiting the national parks. The national parks also offer opportunities to hike and see giant sequoias. These parks have developed visitor centers with interpretive exhibits that are easily accessible for visitors in the Hume Lake District. The Army Corps of Engineers operates the Lake Success, Kaweah, and Pine Flat reservoirs that offer camping, boating, fishing, and trail opportunities. The Mountain Home State Forest, east of Porterville, is managed for forestry education, research, and recreation, and contains a number of giant sequoia trees. In the Central Valley, the California Department of Parks and Recreation offers state parks with campgrounds, picnic areas, trails, historic sites such as Colonel Allensworth State Historic Park, and off highway vehicle areas.

Government Planning

State and local government planning can also influence recreation opportunities in the plan areas. Tulare County aims to promote the continued and expanded use of national and state forests, parks, and other recreation areas to meet the needs of the county's residents (Tulare County 2012). Kern County plans to rehabilitate, renovate, and modernize existing parks and recreational facilities within its park system and improve access to various types of indoor and outdoor recreation opportunities to support year-round recreation programming for all county residents (Kern County 2010). In addition, the county plans to coordinate with other agencies and continue to support the development and delivery of recreation services provided by other agencies in order to meet the needs of its residents (Kern County 2010). Fresno County includes goals in its general plan for coordinating with federal and state agencies for conservation and recreation purposes, and to promote continued and expanded use of federal public lands to meet the needs of residents (Fresno County 2000).

Major portions of Fresno, Tulare, and Kern Counties are located in the Central Valley, which is considered an under-served region for parks, recreation facilities, programs, and services (California State Parks 2009). Growing populations in the Central Valley may increase the demand for recreation opportunities on Sierra Nevada national forests, though the state aims to enhance outdoor recreation opportunities in the Central Valley and work with partners to improve access and opportunities through shared resources (California State Parks 2008).

Opportunities to Foster Greater Connection between People and Nature

The Sequoia National Forest offers a variety of opportunities that connect people and nature through its recreation program. However, Americans have become increasingly disconnected from the outdoors and our natural and cultural heritage (Council on Environmental Quality et al. 2011). The nearly 80 percent of Americans who live in urban areas find it particularly difficult to connect with the outdoors, children spend less than half as much time outside as their parents did, and are "plugged in" to electronic devices for more than seven hours a day (Council on Environmental Quality et al. 2011).

Increasing understanding about the natural environment and helping more people have positive outdoor experiences can create a citizenry that understands the importance of being good stewards of the land. Conservation education and interpretation can play a key role in helping to foster greater connection between people and nature. These programs offer opportunities for experiential learning that can help improve understanding of complex resource issues. In addition, they can be effective tools for encouraging collaboration in resource management. Partnership and volunteer programs can play a vital role by reaching out to a broad and diverse group of citizens and getting them involved on the Sequoia National Forest. These programs are essential to helping the Forest Service carry out its mission, and can help citizens feel a direct and meaningful connection with the land. Opportunities for fostering connection between people and nature are especially apparent within urban communities and with traditionally under-represented groups like youth, low-income populations, and minority populations. Current recreation opportunities and communication and information approaches may be a poor fit for these communities (Winter et al. 2013).

For more information on conservation education, interpretive, volunteer, and partnership opportunities, see the August 2, 2013 snapshot of the Sequoia National Forest Living Assessment Chapter 9, lines 1662-1687. In addition, see lines 1113-1121 for information about why people may not be participating in outdoor recreation opportunities, and lines 1128-1134 for information about opportunities for effective communication about these opportunities.

Recreational Access

Recreation access is the nature, extent, and condition of trails, roads, and other transportation that connect people to recreation settings and opportunities. Recreation access is provided by state highways, county roads, and a designated system of Forest Service roads and trails. Roads and trails not only provide access to recreation opportunities, but are themselves a recreation experience.

Forest roads offer scenic views and provide direct access to trailheads, staging areas, campgrounds, and picnic facilities. Virtually every form of recreation requires motor vehicle access in order to get to the trailhead or other area of the forest. The Sequoia National Forest has approximately 1,646 miles of National Forest Transportation System (NFTS) roads, 507 miles of which are designated at a maintenance level (ML) for highway legal passenger cars (ML 3, 4 and 5). Another 959 miles of roads are designated at a maintenance level recommended for high clearance vehicles (ML 2), though they are open to all street legal vehicles. These roads are also open to off highway vehicles unless otherwise prohibited The remaining 180 miles of roads are closed to all vehicle traffic. The road system is managed and maintained to minimize environmental impact and reduce cost, while providing sufficient access for public and agency needs. With fewer commercial users maintaining portions of the NFTS compared to the past and declining federal budgets, the Sequoia National Forest has had and is expected to continue to have challenges maintaining the road system to safety and environmental standards, resulting in a backlog of deferred maintenance. At the same time, public use of forest roads has grown steadily in recent years, and driving for pleasure is one of the main activities on Forest Service land.

There are 1,056 miles of National Forest System trails on the forest with 196 miles on the Giant Sequoia National Monument. They range in level of development and challenge from accessible interpretive trails to miles of remote, wilderness paths. Many trails are shared by day hikers, backpackers, equestrians, pack stock, off-highway vehicles, and mountain bikers. As population grows and urban development expands, use of forest trails is expected to increase, as is the demand for both motorized and non-motorized recreation opportunities. At the same time, federal budgets are expected to continue to decline, challenging the forest's ability to operate and maintain trails. Partnerships, including volunteers, are expected to continue to be essential for providing high quality recreation opportunities on the forest. High Sierra Volunteer Trail Crew, Back Country Horsemen of California, and off highway vehicle groups such as the Stewards of the Sequoia play a major role in keeping trails maintained on the Sequoia National Forest.

Road and trail maintenance in the Sequoia National Forest are essential for managing recreation opportunities. Increasing use, coupled with decreasing maintenance could lead to erosion and deterioration of roads and trails, closures due to safety concerns and deferred maintenance needs, and subsequent loss of recreation opportunities and quality of experience.

As facilities are constructed or reconstructed, accessibility for persons with disabilities is incorporated in the design. Funding sources have included capital investment program funds, state OHV funds, state Department of Boating and Waterways funds, Secure Rural Schools Act funds, recreation fee receipts, and utility company funds obtained through FERC license conditions. Three accessible trails in giant sequoia groves were developed in the last ten years: the Trail of 100 Giants, the Indian Basin Trail, and the Bush Tree Trail. Major renovation projects have included providing accessible units at Troy and Princess Campgrounds and replacing existing restrooms with accessible vault toilets.

There are currently no public transportation services to the forest.

For more information on recreation access see the August 2, 2013 snapshot of the Sequoia National Forest Living Assessment Chapter 9, lines 505-587.

Scenic Character

Scenic character is a combination of the physical, biological, and cultural images that give an area its scenic identity and contribute to its sense of place. It provides a frame of reference from which to determine scenic attractiveness and to measure scenic integrity (36 CFR 219.19).

Scenic character is a component of the Scenery Management System (SMS), which replaced the Visual Management System (VMS) in 1995. VMS was used to inventory, analyze, and monitor forest scenery resources in the forest plan under the 1982 Planning Rule. However, scenic character has only been determined for the Giant Sequoia National Monument as a result of the 2012 Monument Plan amendment process. Scenic character descriptions for the Monument can be found in the Final Environmental Impact Statement (USFS 2012b) for the Monument. The remaining two-thirds of the forest is inventoried and planned under the VMS and, therefore, does not have scenic character descriptions. Scenic character descriptions identify the existing and potential valued scenic attributes, including landform, vegetation, water bodies, cultural, and historic features. Because scenic character descriptions are not available, the Sequoia National Forest's scenic diversity and features are generally described below.

The Sequoia National Forest occupies the most southern reaches of the Sierra Nevada bio-region and is split into two sections north and south of Sequoia and Kings Canyon National Parks. The Sequoia National Forest is a unique place, highly valued by its neighbors, visitors, and distant admirers. Giant sequoias are a symbolic vestige of the wild Sierra, evoking a deep emotional response, even from people who have never experienced their grandeur firsthand. The Sequoia National Forest offers a wide range of scenic features that include desert-like, foothill and mid to high elevation landscapes. Elevations vary from 1,000 feet to over 12,400 feet above sea level, an indication of the diversity of the area's visual resource. Some of the most outstanding visual attractions include the Kings River Canyon with high, steep walls and massive rocky ridges; the Little Kern River drainage characterized by many streams, small lakes, and alpine meadows surrounded by majestic mountain peaks; and the North Fork Kern River with steep to more "U" shaped canyon walls and clear water flowing in cascades over bedrock and into deep pools. Numerous geologic features that are aesthetically significant combined with diverse vegetation types form the valued images of the Sequoia National Forest (USFS 1988b).

For more information on the scenic diversity of the landscape and scenic attractions see the August 2, 2013 snapshot of the Sequoia National Forest Living Assessment Chapter 9, lines 1216-1231. In addition, visually sensitive state, county and federal roads and trails are listed in lines 11191-1221. These are areas where visitors are expected to have a high concern for scenic values and any changes to scenery.

Scenic character is assessed by looking at scenic integrity and scenic stability. The forest's scenic character and valued scenic attributes have an ecosystem context on which they are based. The "Ecological Units of California" by Charles B. Goudey and David W. Smith serve as the frame of reference for assessing scenic character and its scenery attributes, scenic integrity, and scenic stability (Goudey and Smith 1994). The Sequoia National Forest lies within the Sierra Nevada Section and Sierra Nevada Foothills Section. These sections are described in the August 2, 2013 snapshot of the Sequoia National Forest Living Assessment Chapter 9, lines 199-244. Existing scenic integrity has been documented for one third of the forest that is within the Monument. However the rest of the forest must be reviewed using historic VMS surveys and current aerial photos. Existing scenic stability for the entire forest will need to be determined using vegetation classes, fire return interval departure ratings and forest condition data.

Scenic integrity measures the degree to which a landscape is free from visible disturbances that detract from the natural or socially valued appearance, including any visible disturbances from human activities or extreme natural events outside of the natural range of variability (NRV). Scenic integrity uses a graduated scale of six levels ranging from very high integrity to no integrity. Existing scenic integrity has not been evaluated for the two-thirds of the forest outside of the Monument.

Scenic stability measures the degree to which the valued scenic character and its scenery attributes can be sustained through time and ecological progression. In other words, it looks at the ecological sustainability of the valued scenic character and its scenery attributes. Scenic stability has six levels ranging from very high stability to no stability. Because attributes such as rock outcroppings and landforms change relatively little over time, scenic stability focuses on the dominant vegetation scenery attributes.

Fire regimes in low to mid elevations have shifted from frequent, low intensity ground fires to infrequent, high intensity, stand-replacing fires. At higher elevations, there is an increasing occurrence of high intensity fires (Goudey and Smith 1994). Overcrowded conditions have led to declining tree growth and vigor and increased susceptibility to insect and disease. In addition, the buildup of fuels increases the risk of high intensity, high severity wildfires.

Conditions and Trends Affecting Scenic Character

Landscape-level drivers that affect scenic character include human-caused visual disturbances such as timber harvesting, road construction, mining, utility corridors, recreation facilities, ski areas, and other special uses (USFS 2007). Naturally-caused visual disturbances include catastrophic wildfires, insect and disease outbreaks, and wind and ice storms. Natural events that exceed the natural range of variability (NRV) are considered negative visual disturbances to scenic character, while those within the NRV are considered positive (USFS 2007). Population growth and urbanization, particularly along the Sierra Nevada foothills, is expected to increase demand for energy and communication infrastructure, which could result in a loss of scenery on Sierra Nevada forests, impacting recreation experiences and sense of place.

Extent to Which the Plan Area Meets Recreation Demand and Sustainability of Recreation

Sustainable recreation is the set of recreation settings and opportunities on National Forest System (NFS) lands that is ecologically, economically, and socially sustainable for present and future generations (36 CFR 219.19). To be sustainable, the set of recreational settings and opportunities must be within the fiscal capability of the planning unit, be designed to address potential user conflicts among recreationists, and be compatible with other plan components including those that provide for ecological sustainability.

Population growth in the region is expected to result in more people visiting the Sequoia National Forest and more people placing demands on the forest's resources. The greatest population growth is projected in the southern counties of Kern and Tulare closest to the Sequoia National Forest. The Sequoia National Forest could see even greater increases in demand as a result.

Recreationists also expect more and higher quality recreation experiences from public lands. During the summer weekends and holidays, many developed sites are filled to capacity, and many concentrated use areas are overwhelmed. Dispersed recreation in these areas pose a threat to natural resources when use overruns the ability of the environment to recover from the activity, or financial and personnel resources are not available to manage the use and provide needed services. Although a majority of visitors are quite satisfied with their recreation experience, National Visitor Use Monitoring (NVUM) surveys and public outreach have suggested increasing public concern over the lack of visitor information, accumulating litter, sanitation issues in concentrated use areas, and restroom cleanliness.

Because of the state's rapidly changing population demographics, current recreation facilities and services may not be able to meet future needs. Many campers use large recreation vehicles that are not easily accommodated in existing facilities. Demographic shifts have increased the demand for developed sites that cater to larger groups and this trend will likely continue to increase into the future. Most developed recreation sites have outstanding deferred maintenance backlogs. In addition, current forms of communication and outreach may not be effective for culturally diverse groups and underrepresented groups in general.

At the same time, Forest Service budgets are decreasing and fewer resources are available to maintain and operate existing recreational facilities, develop new opportunities, and provide management of dispersed recreation. In September 2004, the Sequoia National Forest completed a business plan based on its financial and operational position, which included expanding partnerships as a strategy to help the forest address operational shortfalls. Concerns over continued erosion of national forest capacity to manage recreation sites to meet the needs of the public nationwide led to the 2007 RFA analysis process mentioned previously. Since then, budgets have continued to decline, leading to reductions in contracted services, such as trash, water, and sanitation, and in agency personnel to perform recreation services and maintain facilities.

Partnerships and new management strategies have played an increasing role in maintaining and improving developed recreation facilities and trails on the Sequoia National Forest and will be critical to meeting recreation demand in the future. Concessionaires, or private businesses that operate and maintain government recreation facilities under a special use permit, operate approximately 30 developed family campgrounds, as well as group campgrounds, day use facilities, and cabin rentals. The Recreation Enhancement Act has increased the funds available for some recreation facilities and opportunities that the Forest Service manages. Under this Act, the Forest Service collects use fees at nine campgrounds and four day-use sites on the Sequoia National Forest. The fees collected at these sites help provide services and make improvements that benefit the visitors that pay these fees. Outfitter guides, organizational camps, and special recreation events operate under special use permits to provide recreation opportunities to the public. The current level of facilities and programs currently available to the public are dependent on these partnerships with commercial and private operators. Under the Recreation Enhancement Act, 90 percent of the fees collected from outfitter guides and for special recreation events are returned to the forest to provide and improve the recreation experience of visitors.

Conservation and resource stewardship have become and will continue to be an important component of sustainable recreation, especially for more environmentally sensitive areas. It is the pursuit of recreation on the Sequoia National Forest that allows visitors to interact and learn through interpretation and environmental education presented at nature programs and other recreation venues. Unmanaged recreation has the potential to damage forest resources when careless or uniformed visitors do not follow rules for responsible use. Effective interpretive techniques and public information services can help to inform and motivate the public, both visitors and non-visitors, into becoming stewards of the forest (California State Parks 2002; NARRP 2009; USFS 2008b, c).

Contribution the Plan Area Makes to Ecological, Social, or Economic Sustainability

Recreation on the Sequoia National Forest contributes to social sustainability by providing opportunities for people to connect to the land. This in turn, contributes to community wellbeing and helps people develop a stewardship ethic that can further protect the land and contribute to ecological sustainability.

The places that people visit often have emotional meaning that can help define sense of self, as well as social identity. Outdoor recreation also contributes to human health and wellbeing by offering a variety of physical and mental health benefits. Eighty-four percent of the Californians polled in the most recent

Comprehensive Outdoor Recreation Plan (CORP) statewide survey said outdoor recreation was an "important" or "very important" contributor to their quality of life (Roberts et al. 2009).

Recreation, among other activities, on the Sequoia National Forest continues to tie Native Americans to special places that have traditionally been used by their people. The forest also helps visitors make connections with their heritage through its cultural and historical resources.

Recreation opportunities on the forest promote social interactions. Being with friends and family is an important reason why people recreate on national forests, and plays an especially large role for certain groups, like the growing Latino population.

For more information on how recreation contributes to social sustainability, see the August 2, 2013 snapshot of the Sequoia National Forest Living Assessment Chapter 6, lines 912-1360.

Public lands can play a role in stimulating local employment by providing opportunities for recreation. Communities adjacent to public lands can benefit economically from visitors who spend money in the travel and tourism sector in hotels and restaurants, as well as resorts, gift shops, and elsewhere. In 2010, these travel and tourism related industries comprised 15 percent of jobs in the counties bordering the Sequoia National Forest (U.S. Department of Commerce 2012). These counties also receive revenue from sales tax on temporary lodging from visitors who come to recreate on the Sequoia National Forest and other areas. For more information on how recreation contributes to economic sustainability, see the August 2, 2013 snapshot of the Sequoia National Forest Living Assessment Chapter 6, lines 1,464-1,501 and 1,515-1,533.

Information Gaps

Sustainable recreation is a relatively recent concept for the Forest Service. As such, there is little existing information that examines this topic. It is very difficult to quantify the effects of dispersed recreation on the landscape. Generally, the effects of use at each individual location are small, but the cumulative impact to ecological integrity is unknown. The Sequoia National Forest does not currently have an SMS inventory for the entire forest, which includes scenic character. A current SMS inventory is only available for the Monument.

Chapter 10: Energy and Minerals

Important Information Evaluated in This Phase

Available information about the Sequoia National Forest plan area for renewable and non-renewable energy and mineral resources has been identified and evaluated. Energy sources evaluated include hydropower, wind, biomass, and geothermal. Mineral resources evaluated include locatable mineral deposits, mineral materials and abandoned mines. This chapter also evaluates geologic hazards (landslides) on the Sequoia National Forest.

Nature, Extent and Role of Existing Conditions and Future Trends

Hydropower

The Sequoia National Forest has a commercial value to the people of California from hydroelectric power and water storage. With increasing population in the nearby valleys and the need for additional power supplies, opportunities exist to make improvements to existing hydropower projects to enhance power production. These improvements may address localized needs, but will not be sufficient to meet growing demand. No new hydropower projects are anticipated within the planning time frame, however some degree of expansion of current plants may occur. It is unlikely that the forest will see expansion of hydropower development on the rivers on the forest since that potential has already been fully developed. Any increased energy production will be related to improved technology or expansion of existing facilities.

For more detailed information see the August 2, 2013 snapshot of the Sequoia National Forest Living Assessment Chapter 10, lines 6-151 and 319-321.

Transmission Corridors for Energy Development

The forest has no transmission line corridors and there are no existing or planned transmission corridors.

It is highly unlikely that transmission corridors will be developed in the future. The wilderness, wild and scenic rivers, roadless and proposed wilderness areas that run north and south through most of the east side of the Sequoia National Forest make it highly unlikely that a transmission corridor would come through the forests running east or west. Any proposed transmission corridors running north or south would most likely be located in flatter terrain through the San Joaquin Valley (West-Wide Energy Corridor Final Programmatic Environmental Impact Statement 2008 and Record of Decision 2009).

For more detailed information see the August 2, 2013 snapshot of the Sequoia National Forest Living Assessment Chapter 10, lines 303-312.

Wind Energy

Another energy source with potential on the Sequoia National Forest is wind generated electricity. Some potential exists on the Kern Plateau, and in the Piute Mountains, Scodie Mountains, Tule River, and Kings River Canyon areas.

There are no permitted wind power facilities or testing sites approved on the Sequoia National Forest or Giant Sequoia National Monument. The forest has received requests from numerous wind energy companies to explore wind potential by authorizing testing sites but none have been approved at this time. Conflicts with other resources and existing and approved land uses have hindered their approval. The need for additional energy from environmentally sensitive sources will likely increase requests for solar energy and wind energy locations on the forest.

For more detailed information see the August 2, 2013 snapshot of the Sequoia National Forest Living Assessment Chapter 10, lines 153-179 and 317-318.

Biomass

Even though biomass plants are being developed near the Sequoia National Forest, little interest has been expressed in harvesting forest products primarily for power production.

For more detailed information see the August 2, 2013 snapshot of the Sequoia National Forest Living Assessment Chapter 10, lines 182-184.

Geothermal Energy

Possible geothermal resources occur along the Kern Canyon, near Monache Meadows, at California Hot Springs, and along the eastern edge of the Sequoia National Forest. Geothermal exploration and possible development has been previously proposed for the Monache Meadows Area. Oil, gas, and other leasable mineral potential on the forest are very low. Considering the current situation, neither geothermal resources nor oil and gas resources are likely to be developed on the Sequoia National Forest or Giant Sequoia National Monument during the planning period (USDA Forest Service 1988).

For more detailed information see the August 2, 2013 snapshot of the Sequoia National Forest Living Assessment Chapter 10, lines 185-190.

Mining

Past mining activity has been mostly along the Upper and Lower Kern Canyon and in the Piute and Greenhorn Mountains. There are five small mines in operation on public land on the Sequoia National Forest. Past mining activity has been mainly for gold, uranium, and tungsten. Current gold mining activity is confined mostly to weekend recreational prospecting such as gold panning. Activity is not expected to increase.

Mineral potential ratings were developed for locatable and saleable minerals after evaluating basic geology, levels of interest, mineralization, exploration, prospecting and mines. The forest contains about 170,000 acres of low potential, 670,000 acres of medium potential: and 335,000 acres of high or very high potential (USDA Forest Service 1988). Present overall demand for gold, tungsten, and uranium is low.

For more detailed information on mining see the August 2, 2013 snapshot of the Sequoia National Forest Living Assessment Chapter 10, lines 192-215.

Common Variety Minerals

The predominant salable material extracted from the Sequoia National Forest is crushed rock used for road surfacing and fill. The demand for quality rock sources is often dependent on the location of active management operations and the need for resource protection. An adequate suitable quality supply of rock is available across the forest. Demand should continue at 7,000 tons per year. Supply should meet demand over the next ten years. Considering current trends, demand should drop in half primarily because of a reduction in road construction (USDA Forest Service 1988).

For more detailed information on mining see the August 2, 2013 snapshot of the Sequoia National Forest Living Assessment Chapter 10, lines 192-215.

Active Mines

There are currently 36 active mining claims on the Sequoia National Forest and Giant Sequoia National Monument. There are 35 active mining claims on the Kern River Ranger District and one active mining claim on the Western Divide Ranger District (BLM claim records 2010). Mineral exploration, the filing of new mining claims and the opening of older closed mining claims may increase or decrease in response to market conditions. Filing of new claims may result in an increase in abandoned mines when market values decrease and operations cease.

For more detailed information on mining see the August 2, 2013 snapshot of the Sequoia National Forest Living Assessment Chapter 10, lines 243-249 and 322-324.

Abandoned Mine Lands

The Sequoia National Forest and Giant Sequoia National Monument has 255 known abandoned mines (Bureau of Land Management Mining Claim Geographic Index Report 2009). In 1995, the forest began an abandoned mine reclamation program, and has taken action to reclaim approximately four abandoned mines each year.

For more specific information see the August 2, 2013 snapshot of the Sequoia National Forest Living Assessment Chapter 10, lines 255-299.

Geologic Hazards

Landslides are widely distributed across the Sequoia National Forest. Identifying landslide-prone areas is not possible due to the absence of landslide inventory maps. Limited site-specific studies in support of resource management activities and documented landslide incidents have verified landslide occurrence in the last three decades in the Hume Lake, Western Divide, and Kern River Ranger Districts.

Specific landslide types expected to be found are debris slides, debris flows, and rock falls (Varnes 1978). While debris slides and debris flows are likely present throughout the landscape of the Giant Sequoia National Monument and the Sequoia National Forest, rock falls and rock slides would be more common in areas with steep rocky slopes like those found in the canyons of the Kern and Kings Rivers and on the higher elevation slopes within and near the Monarch, Jennie Lakes, Golden Trout, South Sierra, and Kiavah Wildernesses.

A recent example of landslide activity in the Kern River drainage is the Erskine Creek debris flow which took place on July 12, 2008. An intense rainfall from a thunderstorm fell on the slopes north of Piute Peak which had burned in the Piute Fire a few days before. A debris flow issued from Erskine Creek drainage and passed through the community of Lake Isabella about 5:00 p.m. (De Graff et al. 2011). At the same time, two other debris flows swept down Thompson Canyon into Walker Basin and down Clear Creek to the Kern River. The Piute Fire also provides an example of rock fall occurrence. The switchback which brings Piute Mountain Road to the ridge east of Eagle Peak burned hot enough that rocks rolled downslope onto the roadbed, requiring temporary road closure and signs warning the public (De Graff and Gallegos 2012).

Nearly all of the landslides on the Sequoia National Forest are triggered by precipitation. Many are initiated by intense rainfall either as summer thunderstorms or frontal storms drawing moisture from subtropical areas of the Pacific Ocean. Some are triggered by rain-on-snow events where spring rainfall on the warm snow pack causes meltwater to be added to the rainfall amount. Occasionally, late spring warming can result in sufficient snowmelt to trigger movement on existing, dormant landslides. An infrequent but consequential landslide trigger affecting the Sequoia National Forest is earthquakes, such as the 1952 earthquake generated by movement of the White Wolf Fault.

Precipitation events are more likely to induce debris flows and rock slides from slopes recently burned by wildfires (Cannon 2001, Cannon et al. 2011, De Graff and Gallegos 2012). The effect of wildfire on vegetative cover and character of surface soil on burned slopes contributes to their occurrence during the first two to three years following wildfire (Parise and Cannon 2012). Most debris flows from burned watersheds result from a runoff-dominated process, as predicted by models used to estimate the probability of post fire debris flow occurrence and likely volume (De Graff et al. 2011, Cannon et al. 2010, Gartner et al 2008).

The likely effect of climate change would be to increase the occurrence of debris flow and rock fall landslides. Both of these landslide types can be initiated by intense rainfall. Climate change is expected to increase high intensity storm events, which typically trigger debris flows and rock falls. To the extent that climate change increases the number and size of wildfires, there would be an increase in debris flows and rock fall landslides (Cannon and De Graff, 2009).

Contributions the Plan Area Makes to Ecological, Social or Economic Sustainability

The Sequoia National Forest supports the development of power through hydropower generation and conversion of biomass to a power source that meets social and economic demands. Electricity has fueled countless technological advances, and provides the public more food, deeper mines, stronger metals, modern medicines, and bigger cities. There would be no way to support modern society without electrical power, especially given projected population growth.

Hydropower offers numerous advantages over alternative fuels. Hydropower is:

- Renewable -- the earth provides a continual supply of water from rainfall and snowmelt
- Efficient -- hydropower plants convert about 90 percent of the energy of falling water into electricity
- Clean -- hydropower plants do not emit waste heat and gases
- Reliable -- hydropower machinery is relatively simple, reliable and durable
- Flexible -- units can start up quickly and adjust rapidly to changes in demand

Sequoia National Forest hydropower plants play a key role in the economy by offering an affordable power source, which helps keep overall energy prices down. Without hydropower, the country would have to burn more coal, oil, and natural gas. The increasing availability of hydropower also helps reduce California's dependence on other nations for fuel (Value to the Nation – Hydropower – Army Corp of Engineers, 2013).

Current levels of hydropower generation on the Sequoia National Forest appear to be economically or socially sustainable, although climate change may alter precipitation regimes which may, in turn, affect power generation.

Forest wind production is another potential source of energy to meet the growing demand from increasing population around the Sequoia National Forest. Current energy production projections from wind will likely be limited and not on a scale that could support increasing population.

The Sequoia National Forest, in accordance with mining laws and regulations, provides for mineral development which supports economic and social needs. Without minerals, the public would not have electricity, food, or shelter. Minerals make today's technology-based life possible. The public wants the benefits from those minerals, but some would prefer mining to occur outside their area of interest. The Sequoia National Forest has trained mineral administrators who respond to Notices of Intent and Plans of Operation, and issue permits and contracts for minerals materials. These processes allow the forest to work with mining applicants to make sure the mining is done in a sustainable way. Mineral materials play only a minor role to the social, economic and ecological sustainability of the Sequoia National Forest.

Information Gaps

Sufficient information exists on renewable and non-renewable energy and mineral resources for an assessment of the condition, trend and social, economic and ecologic contribution to the Sequoia National Forest plan area to be developed.

Chapter 11: Infrastructure

Important Information Evaluated in this Phase

Infrastructure is considered the built property created to support the use of National Forest System (NFS) lands. The five major categories of infrastructure are transportation, recreation facilities, administrative facilities, public utilities, and private uses.

Nature, Extent, and Role of Existing Conditions and Future Trends

Transportation

The Sequoia National Forest's transportation system has developed and evolved over the past 100 years, with many roads and trails created by users during the 1900s. Most roads were built primarily for vegetation management and mining access during the 1950s to 1980s. Since vegetation management has declined substantially since the early 1990s, public use of forest roads has grown steadily, and driving for pleasure is the single largest recreation use of Forest Service managed lands. National Forest System

(NFS) roads are not intended to meet the transportation needs of the public at large. They are authorized for the use and administration of NFS lands. An appropriate level of maintenance is designated for every road depending on the traffic permitted or required by ongoing resource programs.

The Sequoia National Forest currently manages and maintains a National Forest Transportation System (NFTS) which consists of approximately 1,646 miles of system roads, 370 miles of motorized system trails, and 687 miles of non-motorized system trails. The NFTS is managed and maintained to various road and trail standards depending on management objectives. The roads range from paved roads to roughly graded high clearance roads, depending on the type of access necessary. In some cases, where no access is currently needed, roads are "stored" for future management use by closing them to all motor vehicle traffic.

There are motorized routes on the Sequoia National Forest that are not part of the NFTS. These routes evolved in different ways. Some were built as temporary roads, often for vegetation management access, and some are user-created routes from unauthorized use. Since they are not part of the NFTS, these routes are not maintained by the Forest Service and are not shown on motor vehicle use maps. The Forest Service goal for these routes is rehabilitation and restoration to natural conditions. The Sequoia National Forest focuses on the road system over which the Forest Service has jurisdiction.

Maintenance levels and system roads on the Sequoia National Forest

Maintenance Level	Miles of System Roads		
	Monument	Rest of the forest	Total Miles on the forest
ML 1	71	109	180
ML 2	515	444	959
ML 3	127	160	287
ML 4	72	67	139
ML 5	37	44	81
Total Miles	822	824	1,646

Miles of system trails in the Monument and rest of the forest by allowed use

Allowed Use	Monument	Rest of the forest	Total Miles on the forest
Motorized	4.7	364.9	369.6
Non-Motorized	191.3	495.6	686.9
Total Miles	196	860.5	1,056.5

For more detailed information, see the August 2, 2013 Sequoia National Forest Living Assessment Chapter 11, lines 9-373.

The Sequoia National Forest completed a motor vehicle travel management project to implement the provisions of the 2005 Travel Management Rule (36 CFR Part 212, Subpart B). In October 2009, the Sequoia National Forest Motorized Travel Management decision prohibited motor vehicle travel off of the designated system of roads and trails. Many of the roads and motorized trails that were added to the system were required to have mitigation such as water bar installation, route hardening, or minor rerouting completed prior to designation for public motorized use in order to minimize resource impacts. Since the Record of Decision was signed, crews and volunteers have been completing mitigation measures and installing signage on roads and motorized trails, and have been completing closures of unauthorized routes. Despite the increase in miles of system roads and trails, budgets did not increase. In addition to using appropriated funds to support the implementation of travel management, the forest has relied on the aid of state off highway vehicle funds and volunteers.

For more detailed information, see the August 2, 2013 snapshot of the Sequoia National Forest Living Assessment Chapter 11, lines 301-337.

There are still motorized and non-motorized routes on the forest that are not currently part of the NFTS and are considered unauthorized. These routes are not maintained. The Sequoia National Forest is currently completing the Travel Analysis Process Subpart A which is a science-based analysis of the resource risks and access benefits of the existing road system. This analysis will identify potential opportunities for changes to the existing road system, which could be implemented after appropriate NEPA analysis.

The annual cost of performing all needed maintenance activities according to the required cycle for the Sequoia National Forest road system.is approximately $5,142,250. In past decades, commercial users maintained a substantial portion of the transportation system in the Sequoia National Forest. With the decrease in vegetation management, fewer roads are being fully maintained. Additionally while maintenance budgets decrease and the maintenance backlog grows, safety standards have become more stringent. The most recent estimate of deferred maintenance needs on the Sequoia National Forest is $49,728,000 for roads and $5,811,090 for all trails (USDA 2012 INFRA).

For more detailed information, see the August 2, 2013 Sequoia National Forest Living Assessment Chapter 11, lines 114-190.

Ongoing motorized and non-motorized trail maintenance on the Sequoia National Forest is traditionally funded through appropriations. Appropriated trails funding is expected to remain flat or to slightly decrease over time. At the same time, increased and changing use causes more damage to motorized trails, resulting in greater costs to keep the trails stable. Motorized users are increasingly using larger trail vehicles, and widening motorized trails. Heavier equipment, like graders, is needed more often than in the past to maintain these motorized trails.

State and county roads serve as major access routes for forest users. The Sequoia National Forest can be accessed by several points of entry including State Highways 180, 245, 99, 65, 190, 155, and 178. For more detailed information see the August 2, 2013 snapshot of the Sequoia National Forest Living Assessment Chapter 11, lines 338-373.

When roads and associated drainage-control features contribute flow directly to a natural water body, they become part of the drainage network and are said to be hydrologically-connected. These drainage systems may further increase hydrologic connectivity if they deteriorate because of use, weather, or inadequate maintenance. For more detailed information see the August 2, 2013 snapshot of the Sequoia National Forest Living Assessment Chapter 11, lines 85-112.

As a result of decreasing budgets, routine maintenance is reduced, maintenance cycles are extended, and selective repairs are made to ensure public safety and prevent significant resource damage. Current and projected funding levels do not cover deferred maintenance, which means that the deferred maintenance backlog grows each year. For example, roads that are to be maintained once every five years may be maintained only once every 10 years. Over time, roads may develop severe public safety or resource damage issues, and may need to be evaluated for closure to public motorized vehicular use. Existing funding for maintenance is insufficient to fully maintain the NFTS. Lower priority roads (ML 1 and 2) are causing deterioration of the roadway. Some roads and trails have become overgrown with brush and trees and are impassible to vehicular traffic. Therefore, the highest priority for road maintenance is expected to be ML 3 to 5 roads for public and administrative access, and reasonable access to private property. Other roads that provide access to private lands, important fire protection features, administrative sites, special use permit areas, and recreation areas are also expected to be maintenance priorities.

Road and trail maintenance on the Sequoia National Forest is essential for managing recreation opportunities. While recreation demand in the future is expected to increase, anticipated appropriated funding will not be enough to fully fund the operation and maintenance of roads and trails. Not performing the routine annual maintenance on time may increase the amount of deferred maintenance. As a result, fewer of the roads and trails will be fully maintained to standard. Roads and trails not receiving proper maintenance will inevitably be affected. Both public and administrative accesses are expected to continue to be degraded, and that will encourage road and trail decommissioning.

Recreation Facilities

There are approximately 158 recreation facility sites and other structures managed by the Sequoia National Forest, which support recreation activities. Within the recreation sites there are approximately 247 buildings. The Sequoia National Forest owns and manages approximately 77 water system units that serve recreation sites. The majority of the water systems are generally located in developed campgrounds. The forest also owns and manages approximately 70 waste water systems that serve recreation sites.

The current estimate of deferred maintenance needs for all water systems in the Sequoia National Forest is $3,194,226 and $1,399,703 for waste water systems (USDA 2012 INFRA). These totals include water and waste water systems that serve administrative facilities as well as recreation facilities. While there are no water systems closed to public use from non-compliance with drinking water standards, some water systems are closed because of inadequate funds to do the required maintenance, water sampling, and testing. Due to budget constraints, annual maintenance has not been accomplished each year when scheduled. Deferred maintenance has continued to increase each year. Potable and non-potable water systems are subject to all federal, state, and local requirements.

The Sequoia National Forest cannot accomplish all developed site annual maintenance to standard with existing resources, including concessionaires. Many of the facilities were built 40 to 50 years ago and have reached the end of their useful life, without significant investment to accomplish deferred maintenance. Other facilities receive little use and may no longer serve the demand that existed decades ago. Annual maintenance has not been accomplished each year when scheduled as a result of budget constraints. Throughout the Sequoia National Forest, dispersed campsites are generally improved for resource protection rather than user convenience. Many dispersed campsites have been improved, but much of the maintenance identified has been deferred. Deferred maintenance has continued to increase each year.

Continued reduction in working budgets and personnel levels, including the need to reduce fixed costs, indicates that the Sequoia National Forest must actively maintain facilities to preserve these assets. For more detailed information see the August 2, 2013 snapshot of the Sequoia National Forest Living Assessment Chapter 11, lines 386-449.

The Sequoia National Forest receives annual funding to maintain recreation facilities. Funding has fluctuated over the years, but appears to be declining. In addition to the yearly allocation for facility maintenance, the Sequoia National Forest competes for capital improvement funding to improve or develop recreation facilities. The majority of the buildings on the Sequoia National Forest are 40 years or older, and many need to be replaced or rehabilitated. Inability to provide needed maintenance and replacement would result in continued deterioration of buildings. When buildings can no longer function to support forest management, they will be abandoned or demolished, and no longer provide support to management activities. Management activities supported by these buildings would become less efficient or very costly to accomplish.

In general, recreation facility maintenance is funded by appropriated funds (facilities construction and maintenance). Due to the amount of appropriated funds relative to the number of recreation sites, the base allocation is mostly spent on management costs of recreation facilities and very little of this funding is spent on actual facility maintenance.

Most of the developed campgrounds in the Sequoia National Forest are run by concessionaires under Granger-Thye permits. The current Granger-Thye authority allows a fee offset to occur, where the permittee returns a percentage of their proceeds back to the federal government for the purpose of maintaining the recreation sites under that permit. The amount of Granger-Thye funding received fluctuates each fiscal year. Funds have generally been used for major repairs of recreational facilities such as toilet building replacement, major repairs to utility systems, and replacement of other site amenities such as signs, food storage lockers, and fire pits. Concessionaires are responsible for performing routine annual maintenance as part of their permits. Therefore the Granger-Thye funding received by the Sequoia National Forest is used for those things above and beyond annual maintenance, and could be considered as offsetting deferred maintenance.

Funding sources for recreational facilities include appropriated funding, fee collections, and donations. Most of these funds are used for operational expenditures associated with facilities and under special circumstances, are sometimes used for site improvements. For more detailed information see the August 2, 2013 snapshot of the Sequoia National Forest Living Assessment Chapter 11, lines 459-494.

Administrative Facilities

The Sequoia National Forest owns and manages approximately 194 administrative buildings, including nine lookout towers, two fully operational heliport stations and four helispots, and four leased buildings, and occupies four buildings jointly with other agencies. Approximately 40 percent of the forest-owned buildings are 50 years or older. These buildings are in various stages of repair and some need to be replaced. Existing buildings were constructed and located based on past needs. With declining budgets and work force, some buildings are no longer needed; however, some of the buildings have potential as heritage resources structures, which could make the decommissioning process more difficult. Annual maintenance has not been accomplished each year when scheduled, due to budget constraints.

The Sequoia National Forest owns and manages approximately 30 water system units and 50 waste water systems that serve administrative sites. Potable and non-potable water systems are subject to all federal, state, and local requirements. The current estimate of deferred maintenance needs for all water systems on the Sequoia National Forest is $3,194,226, and for waste water systems it is $1,399,703. These totals include water and waste water systems that serve recreation facilities as well as administrative facilities.

For more information, see the August 2, 2013 snapshot of the Sequoia National Forest Living Assessment Chapter 11, lines 504-596.

The Sequoia National Forest receives annual funding to maintain administrative facilities. Funding for the past decade has fluctuated, but appears to be declining. Due to the aging of buildings and additional deferred maintenance costs and budget reductions, national direction is to focus on decommissioning facilities and reducing square footage. As with recreation facilities, special projects are funded on a competitive basis. Projects that reduce deferred maintenance or reduce square footage are most likely to be funded. The facilities master plan is expected to be updated soon to help the forest prioritize which buildings to retain and which buildings to decommission.

Requirements and regulations from the state and county are increasing. Needed modifications cannot be performed due to limited funding and buildings continue to collect deferred maintenance. The inability to provide needed maintenance and replacement is expected to result in continued deterioration of the buildings. When buildings can no longer function to support forest management, they will be abandoned, and no longer provide support for management activities. Management activities supported by these buildings would become less efficient or more costly to accomplish.

For more detailed information see the August 2, 2013 snapshot of the Sequoia National Forest Living Assessment Chapter 11, lines 611-635.

Public Utilities

The Sequoia National Forest has approximately 120 public utility structures on the forest to carry out their services, the largest carrier being Southern California Edison Company. These utilities include power lines, oil and gas pipelines, network lines, telephone lines, cable television, water diversion, waterlines, and water wells. Hydroelectric power generation is the primary form of energy production on the forest. There are six hydroelectric plants currently in operation on the forest.

Other energy sources with potential on the Sequoia National Forest are wind-generated electricity, biomass energy, and geothermal energy. Demand for electricity has maintained a slow, steady increase due to population growth and these trends are expected to continue. Authorizations for public utilities are discussed in Chapters 10 and 14 of this assessment. For more detailed information see the August 2, 2013 snapshot of the Sequoia National Forest Living Assessment Chapter 11, lines 648-668.

Expansion of public utilities may be required if more land becomes available for development adjacent to National Forest System (NFS) lands. This would mainly affect the smaller public utilities. New energy development, either on or off NFS lands may require expansion of public utilities, especially transmission and distribution lines. As communities adjacent to NFS lands continue to be developed, water well proposals will most likely increase. Transmission corridors are discussed in Chapter 10 of this assessment. For more detailed information see the August 2, 2013 snapshot of the Sequoia National Forest Living Assessment Chapter 11, lines 669-674.

Private Uses

Construction and maintenance of private infrastructure operated under special use authorization are the direct responsibility of the permit holder. Permit holders are required to ensure that their facilities comply with building codes, state water protection regulations, the National Historic Preservation Act, and other federal, state, and local codes that may apply. There are approximately 15 miles of private roads and three and a half miles of commercial use roads on the Sequoia National Forest. This figure may underestimate the miles of private roads on the forest because many have not been entered into the database. For more discussion on private uses, authorization and easements please refer to Chapter 14 of this assessment. On the Sequoia National Forest, 224 special use permits are currently in place for private infrastructure.

For more information, see the August 2, 2013 snapshot of the Sequoia National Forest Living Assessment Chapter 11, lines 692-758.

As population increases, there will be more demand for private land within the boundary of the forest. As the public demand for privately provided recreation opportunities increases, proposals for new infrastructure could increase. For further discussion, please see Chapter 9 of this assessment. Forest Service policy is that a proposal by a private individual to develop groundwater on adjacent National Forest System land would not be accepted. Any proposal to use surface water would require a state water right. See Chapter 8 of this assessment for trends related to water uses. For more detailed information see the August 2, 2013 snapshot of the Sequoia National Forest Living Assessment Chapter 11, lines 759-765.

Contributions the Plan Area Makes to Ecological, Social, or Economic Sustainability

Sequoia National Forest lands have met public need for wood, water and outdoor recreation for more than a century. Today, the Sequoia National Forest's many developed recreation areas, its giant sequoia groves and rugged wilderness make it popular with the recreating public. Timber management, fuel treatment, access to private in-holdings, fire control, utility management, special uses, recreation and harvesting of special forest products are among the many opportunities afforded by the transportation system.

Information Gaps

Although not all the buildings have available information, current staff strives to fill this data gap as much as possible.

Currently data in the special uses database (SUDS) are unreliable. Key information is either missing or needs validation. Crucial data gaps exist due to needed updates to permit holder records, and inventories of current on-the-ground facilities and as-built site plans. Capital investment information for facilities is unavailable. Spatial data related to special uses is either non-existent or inaccurate.

A needs assessment, capacity analysis, and market research are not available to determine if existing private special uses infrastructure is sufficient to meet the public needs.

The Sequoia National Forest does not currently track the amount of water usage by special use permit holders. This means there is no baseline data to evaluate the effectiveness of water conservation measures or for making projections about future demand versus supply.

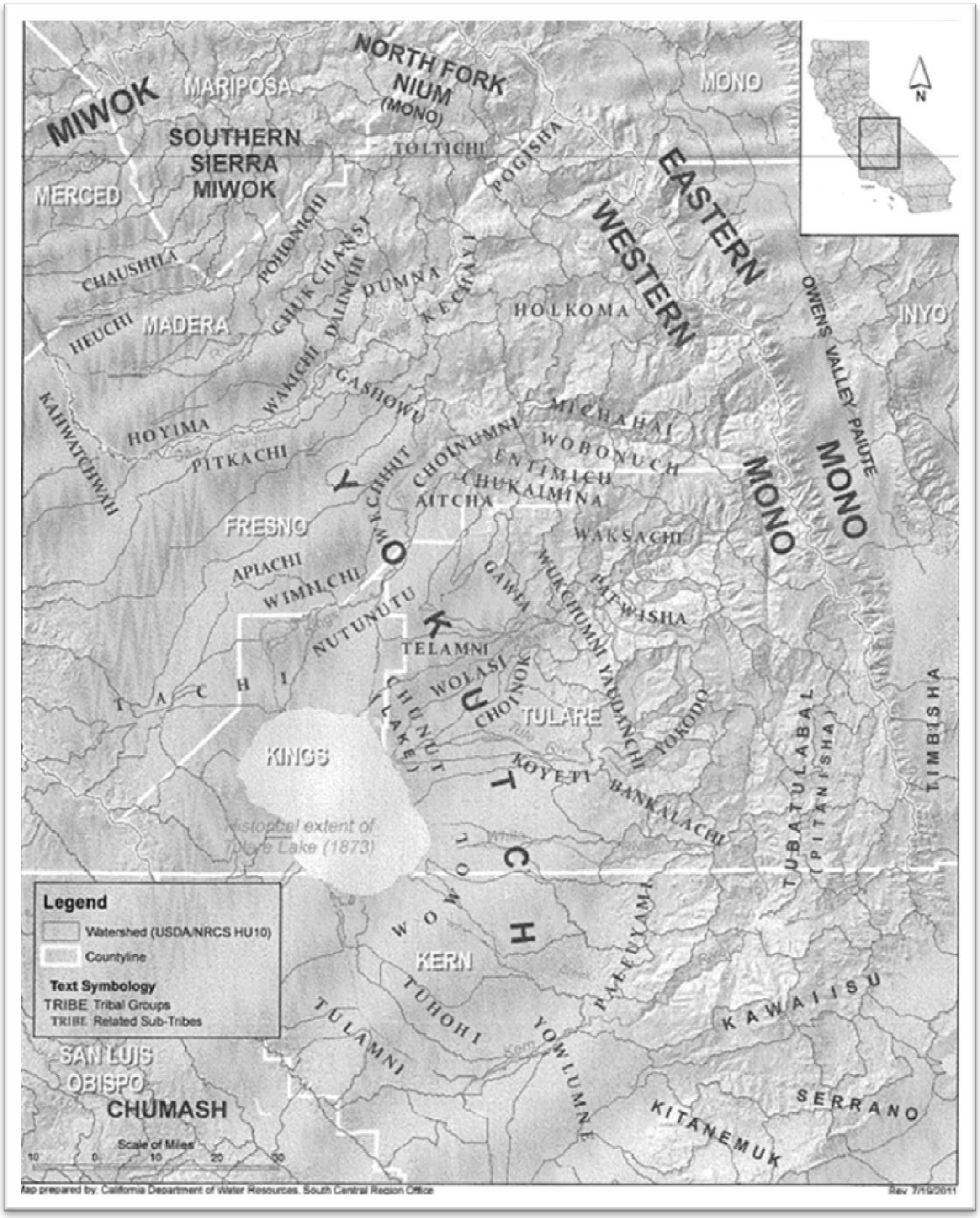
Chapter 12: Areas of Tribal Importance

Important Information Evaluated in this Phase

In this chapter, Indian Tribes associated with the plan area, existing tribal rights, and areas of known tribal importance are identified. Existing information was used to assess condition and trend of resources that affect tribal rights and areas of tribal importance. Unless otherwise cited, this information largely comes from the Sequoia National Forest's Tribal Program, as described in the August 2, 2013 snapshot of Chapter 12: Assessing Areas of Tribal Importance – Sequoia National Forest Living Assessment. Additionally, the section on condition and trend drew heavily from tribal forum notes, individual tribal meetings and consultation meeting notes, regional roundtables and listening session notes, and written comments gathered throughout the forest plan revision process.

Nature, Extent and Role of Existing Conditions and Future Trends

Indian Tribes Associated with the Plan Area



Historic Tribal Groups of the South Central Homeland

Native American people have occupied areas on the Sequoia National Forest for thousands of years. Archaeological evidence and historical and ethnographic accounts attest to the diversity, longevity, and importance that Native American groups have had in this area. The historical tribal groups of the South Central homeland are shown in the map above, prepared by the California Department of Water Resources (2011). Additional ethnographic and tribal territory maps can be found in the August 2, 2013 snapshot of the Sequoia National Forest Living Assessment Chapter 12, lines 483-491.

Tribes associated with the plan area include federally recognized tribes, California Native American tribes that are not federally recognized, and tribal organizations.

Federally recognized tribes:

1. Table Mountain Rancheria
2. Tule River Indian Reservation – Yokuts
3. Santa Rosa Rancheria – Tachi-Yokuts
4. Bishop Paiute Tribe
5. Big Pine Paiute Tribe
6. Lone Pine Paiute-Shoshone Reservation
7. Tejon Indian Tribe

California Native American tribes – non-federally recognized:

1. Dunlap Band of Mono Indians
2. Traditional Choinumni Tribe
3. Kings River Choinumni Farm Tribe
4. California Choinumni Tribal Project
5. Northern Band of Mono Yokuts
6. Tubatulabal Tribe
7. Kern Valley Tribal Council
8. Wukchumni Tribal Council
9. Kawaiisu Tribe
10. Wuksachi-Michahai Tribe
11. Kitanemuke & Yowlumne Tejon Indians
12. Squaw Valley Tribe

Tribal organizations:

1. Kern River Paiute Council – Nuuicunni Cultural Center & Museum
2. Eshom Gathering (Davis Clan)
3. Monache Intertribal Association
4. California Indian Basket Weavers Association (CIBA)
5. Tule River – Yokut Archeology Advisory Team (YAAT)
6. Tule River Tribal Elders Committee
7. Tribal Technical Assistance for Needy Families (TANF) - Owens Valley Career Development Centers (Lake Isabella, Visalia, Fresno/North Fork/Big Sandy Rancheria offices)

Existing Tribal Rights

Native Americans and Alaska Natives are recognized as people with distinct cultures and traditional values. They have a special and unique legal and political relationship with the United States government as defined by history, treaties, statutes, executive orders, court decisions, and the United States Constitution. The policy of the government is to support Native American cultural and political integrity, emphasizing self-determination and government-to-government relationships. Tribal consultation is required by federal law and is reinforced by court decisions, executive orders, and agency policies.

The Sequoia National Forest is responsible for maintaining a government-to-government relationship with federally-recognized tribes and ensuring that forest programs and activities honor Indian rights and privileges. The Sequoia National Forest also confers with non-federally recognized tribes, organizations and individuals. Existing tribal rights related to the plan area include water rights, native plant gathering rights, and hunting and fishing rights. In addition, cultural spiritual sites are also protected.

The South Fork Tule River is the sole source for surface water for the Tule River Indian Reservation, which borders the Sequoia National Forest. There are a few springs on which the Tribe also depends. Tule River Indian Reservation has water rights under the Winters Doctrine in order to create and to support it as a viable homeland for the Tribe and its members. The Tribe actively manages the headwaters land and timber resources to protect the integrity of the watershed and the quality of the water on which it depends. The Tribe also has important cultural areas within the headwaters area.

For more information on tribal rights, and associated laws and policies, as well as roles and responsibilities, see the August 2, 2013 snapshot of the Sequoia National Forest Living Assessment Chapter 12, lines 4-36, 179-196 and 266-402.

Different types of agreements are used to strengthen and enhance relationships with tribes. The Sequoia National Forest has one agreement in place concerning Sequoia National Forest Protocol for the Inadvertent Discovery and Identification of Native American Human Remains, Funerary Objects, Sacred Objects and Objects of Cultural Patrimony. This applies to federally and non-federally recognized tribes. The Sequoia National Forest is in negotiation on a Memorandum of Understanding (MOU) with the Tule River Indian Council that formally recognizes the government-to-government relationship. This MOU would outline a framework for increased cooperation between the agency and the tribe in order to develop community opportunities and partnerships in areas of mutual interest. It would also document the importance of the tribe and its need to have access to and the use of certain natural resources existing within the Sequoia National Forest. While other tribes have expressed interest in similar MOUs and the Forest has promoted their development, no formal negotiations have taken place.

Areas of Known Tribal Importance

Identifying and evaluating areas of known tribal importance in the plan area or affected by management of the plan area is a challenging concept, given the tight bond between tribal people and the land. Fundamental to their social consciousness is the belief that they are tied to the land by a pledge that they will tend to the resources and comply with traditional instructions, and in return, the land will nurture them. The indigenous peoples of the Sequoia National Forest have an unbroken union with the area that has survived for at least 14,000 years. Thus, the rivers, mountains, and meadows seen on a map are as familiar to them as the items in your living room are to others. Tribal people are as concerned about impacts to those areas as others might be if someone were to vandalize or destroy or take their furniture.

One way to better understand areas of tribal importance is to classify them according to the following social institutions:

- *Family: areas important for defining and understanding kinship.* Many areas on the forest are important for these purposes. A very limited list of examples include: the Kings River, Kaweah River, Tule River, and Kern River.
- *Government: areas important for defining and understanding political boundaries and the political structure of tribes.* These include identified tribal aboriginal territories, rivers, rancherias, reservations, tribal allotment lands, trust lands, and tribal lands that were converted to fee lands.
- *Economy: areas important for gathering and distributing wealth and resources*. These include sedge beds, sour berry patches, meadows, elderberry patches, black oak groves, river mussel beds, fisheries, and hunting grounds. In terms of trade, areas of tribal importance include trails and areas where acorns, pine nuts, obsidian, and materials for beads, baskets, clothing, and tools are currently collected and have been for generations.
- *Education: areas important for training and transferring knowledge about traditional practices.* These include areas such as campsites, trails, bedrock mortar/milling stations, fandango grounds, sweat lodges, village sites, gathering sites, and rock art sites.
- *Religion: areas important for spiritual power and religious activities.* These include ceremonial areas, vision quest areas, burial grounds, sweat lodges, Bear Dance sites, Ghost Dance sites, meadows, granite domes, peaks, rock art, waterfalls, potholes/pools, caves, and rock shelters.

Conditions and Trend of Resources that Affect Tribal Rights and Areas of Tribal Importance

Federally recognized tribes, along with other local tribes, groups, and individuals who have not been federally recognized, look to the Sequoia National Forest for traditional and contemporary uses and currently consider it part of their ancestral homeland. With open space around the national forests disappearing because of population growth and urbanization, the Native American community will increasingly look to the national forests to meet their needs for traditional foods, plants, and places of solitude to conduct traditional activities. Tribes are concerned about the protection of, and access to resources of cultural or traditional importance and areas with special or sacred values, often the locales of ceremonial activities. This includes use of Forest Service roads that access reservation land, protection of the Tule River watershed, and protection of reservation lands from fires that start on the forest.

The following issues related to water resources are affecting tribal rights and areas of tribal importance and are expected to continue to be issues in the future: conflicts between tribal and Sequoia National Forest reserved water rights, water-based recreation activities infringing on areas used for ceremonies, and the lack of information on areas of spiritual significance causing misunderstandings with how and where to manage vegetation. Because information is often culturally sensitive and confidential, tribes often do not disclose locations of sacred or spiritual areas to protect and preserve them. With the expected increase in uncharacteristically large fires, as well as impacts from climate change, tribes may end up needing to establish new sacred sites or ceremonial areas in the future (Goodwin 2013).

Tribal gathering is currently and will continue to be affected in the future by climate change, competitive uses on the forest, increasing recreation demands, grazing, altered fire regimes, ability to do traditional burning and management, agency fuels and vegetation management, and non-native species. Gathering may be impacted if tribes cannot access plant materials outside known gathering areas. Tribes continue to find new sources of plant material during their gathering processes or during Forest Service project implementation.

Tribes are concerned about the safety of routes off rancherias and reservations through public lands using Forest Service roads. Many indigenous trails are still used by tribes, such as the Mono-Paiute Traditional Sierra Walk, and this use should be considered in forest management.

Forest Service road maintenance, construction, and decommissioning have impacted tribes positively and negatively. There is currently a tension between these positive and negative effects. Upgrading a road may facilitate and increase access to areas of tribal importance. At the same time, improvements can also diminish those qualities held to be sacred or culturally important and can potentially introduce traffic into areas used for ceremonies. Limiting access can protect cultural resources, but may impact other forest users. Decommissioning roads can negatively affect areas of tribal importance when roads are eliminated that are themselves cultural resources with important historical associations. The ground disturbance associated with decommissioning can disturb archaeological deposits on or near the road. At the same time, reducing access can also prevent vandalism and damage to cultural resource sites.

Sequoia National Forest consultation with tribes has helped and continues to help resolve this tension. Overall, tribal relationships with the Sequoia National Forest have improved as a result of increased consultation and collaboration. Resolving these tensions in addition to other issues through tribal consultation and collaboration on projects will continue to be an ongoing process. Furthermore, there has been increasing collaboration with Forest Service scientists in order to better incorporate traditional ecological knowledge into their work, for example, with black oak. At the same time, decreasing federal budgets and resources available for the tribal program will make efforts to work with tribes increasingly challenging in the future. Personal, face-to-face interaction with tribes is vital to developing strong relationships with tribal communities and to having successful consultation.

Scenery management on the Sequoia National Forest is important to tribes. The Native American community feels a close association with cultural and historic landscapes. Any activity that promotes scenery management and aims to maintain the feeling of the natural-appearing landscape has a beneficial effect. Any alteration or permitted degradation of scenic integrity from the more natural settings or the settings associated with the cultural resources may affect cultural or historic landscapes or traditional cultural properties. For more on scenery management see Chapter 9 of this assessment.

Impacts of recreation to local tribal cultures need to be taken into account as well. Tensions are growing among American Indians and those using and managing the outdoor recreation resources of the West (McAvoy 2002). The agency is required by law to administer the National Forest System for outdoor recreation, among other uses including range, timber, water, wildlife and fish. Untold numbers of Native American sacred sites and traditional places are located on these same lands, and tribal practices are tied to these resources. Economic and recreational drivers are important in land management decision-making, but sacred site concerns are equally important. American Indians are part of the Old and the New West. They have historic, contemporary and symbolic links with the landscapes of the West, including the landscapes in and near the major recreation, park and tourism resources. Increasing user visits or directing recreational or user traffic toward sacred sites or traditional cultural properties may have an adverse effect on the location, as well as the religious, ceremonial or cultural activity of the tribes (Goodwin 2013). Traditional religious practices require solitude and secrecy, which are more and more difficult to provide on a forest where the size and scope of activities is increasing but the land base is not.

Reburial requests from several federally-recognized tribes on the Sequoia National Forest have increased since the Food, Conservation, and Energy Act of 2008, Subtitle B – Cultural and Heritage Cooperation Authority (the Farm Bill of 2008), Section 8103: Reburial of Human Remains and Cultural Items. The Forest Service was given authority to honor these reburial requests received from tribes on ancestral National Forest System (NFS) lands. Ongoing coordination is occurring between tribal representatives and forest officials to identify and designate locations on NFS lands. This will lead to new areas that may be impacted by forest management activities. Additionally, many of these sites are extremely sensitive and tribes do not want their locations known.

Contributions the Plan Area Makes to Ecological, Social or Economic Sustainability

The plan area contributes to social and economic sustainability by helping to maintain Native American culture, traditions, and lifeways, which are deeply connected to the land. Forests in the entire Sierra Nevada bio-region play an important role in supporting and protecting the rights and privileges of tribes that help them maintain their culture. Every national forest is carved out of ancestral Native American land, and Native American historical and spiritual connection to the land has not been extinguished or diminished despite these changes in title. For thousands of years, their land use ethic included spiritual, philosophical, and economic dimensions (Anderson and Moratto 1996). Many Native Americans participate in traditional activities, such as hunting, fishing, trapping, and gathering berries, and do not differentiate these activities into distinct categories, such as work, leisure, family, culture, and tradition (McAvoy et al. 2004). These activities carry on family and tribal traditions, provide sustenance for families, and continue a spiritual connection to the land and to animal and plant resources (McAvoy et al. 2004). These activities, and the places connected to them, have cultural, symbolic, and spiritual as well as functional meanings (McAvoy et al. 2004).

The relationship between tribes and the Sequoia National Forest contributes to ecological sustainability through the management and restoration of ecosystems. Because social, economic, and ecological aspects of life are so integrated within Native American culture, many of the ecological benefits of working with tribes can also have social and economic benefits for tribal communities. In Native American culture, humans are viewed as part of the natural system, helping to ensure abundance and diversity of plant and animal life (Anderson and Moratto 1996). Native Americans practiced land management though burning, irrigating, pruning, selective harvesting, sowing, and weeding. The removal of Native American management from the landscape has influenced and continues to influence Sierra Nevada forests. Resource management by Native Americans in the Sierra Nevada bio-region was long term and widespread, producing ecological and evolutionary consequences in the biota (Blackburn and Anderson, as cited in Anderson and Moratto 1996). Therefore, many ecosystems in the Sierra Nevada are not self-maintaining islands that require only protection to remain in a “pristine” state. There is currently an ecological “vacuum,” or disequilibrium, in the Sierra Nevada resulting from the departure of Native Americans from managing these ecosystems. The decline in biotic diversity, species extirpation and endangerment, human encroachment into fire-type plant communities like chaparral, and greatly increased risk of catastrophic fires are thought to be symptoms of this disequilibrium.

Tribal communities within the Sierra Nevada present distinctive opportunities for mutually beneficial partnerships to restore ecologically and culturally significant resources, and to promote resilience (Charnley et al. 2013). Lessons learned over thousands of years can help us develop long term strategies to restore the nation’s forests. Traditional ecological knowledge and western science can be blended for successful outcomes on the landscape. Tribes can also be supportive partners for management decisions. Tribal partners can facilitate larger collaborative efforts between federal agencies. Tribes work with nearly all state and federal agencies, and have access to private funding and their own programs. Recognition of their strength as partners can help accomplish landscape scale restoration. In addition, working with tribes can provide them with more opportunities to be direct stewards of the land, which is a vital part of Native American culture. Active participation in forest management activities can also create jobs and improve economies in tribal communities.

Information Gaps

Limited information is available on condition and trend of resources that affect tribal rights and areas of tribal importance. Part of this is due to the nature of areas of tribal importance. Many of these areas are sensitive or sacred, and tribes wish to keep these areas confidential in order to protect them. In addition, there is still much the Sequoia National Forest is learning about tribal culture and values, as well as traditional ecological knowledge. As discussed further in Chapter 13 of this assessment, the current expanded definition of cultural resources includes categories of resources extremely important to the sustainability of tribal culture but that were traditionally viewed as “natural.” Additional categories of sites, districts, and cultural landscapes likely exist but have yet to be identified and evaluated.

Chapter 13: Cultural and Historical Resources and Uses

Important Information Evaluated in this Phase

In this chapter, cultural and historical context of the Sequoia National Forest is examined and cultural and historic resources present in the plan area are identified. Existing information is used to assess the condition of these resources, including historic properties in the plan area identified as eligible or listed in the National Register of Historic Places and designated traditional cultural properties. Trends that affect these conditions or demand for these resources are also assessed.

This information comes from the forest's Heritage Resources Program, as described in the August 2, 2013 snapshot of the Sequoia National Forest Living Assessment. For more details on internal and external information sources used to develop the Living Assessment, see the Sequoia National Forest Living Assessment Chapter 13, lines 378-504. Information also came from the July 2, 2013 snapshot of the Sierra National Forest Living Assessment Chapter 13, which included information also applicable to the Sequoia National Forest, particularly historical context, trends, and contributions to sustainability.

Nature, Extent and Role of Existing Conditions and Future Trends

Cultural and Historical Context

Prehistoric Period

People first arrived in California more than 13,000 years ago (Johnson et al. 2002). Archaeological data indicate that humans have inhabited the southern Sierra Nevada, including the Sequoia National Forest, for at least 9,000 years. The earliest human occupation of the Sequoia National Forest could have come from either the west or southeast. Currently the forest cultural history makes use of McGuire and Garfinkel's (1980) work along the Pacific Crest Trail, where there is a major Great Basin influence. This is the only large scale archaeological study ever undertaken on the Sequoia National Forest. However, because of its unique geographic position compared to the rest of the southern Sierra, the lack of forest-specific archaeological data, and the unresolved question of influence, chronologies for the southern Sierra Nevada, the Great Basin and the San Joaquin Valley are all presented here.

Southern Sierra Nevada: As described in McGuire and Garfinkel (1980), from 9,000 to 6,000 years before the present (B.P.), the southern Sierra Nevada area was only used by nomadic groups on a sporadic basis. Between 6,000 and 3,200 B.P., conditions became warmer and drier, causing a shift and expansion into the piñon-juniper zones. Visits to the area were still sporadic. Between 3,200 and 1,400 B.P. is when the first intensive occupation of the southern Sierra Nevada occurred. There was a shift toward more intensive use of plant resources, including piñon pine resources. From 1,400 to 700 B.P. settlement sites increased in numbers and became more dispersed. Bedrock mortars and pestles appear for the first time, indicating a more diverse subsistence and intensification of acorn processing. The time from 700 B.P. to the historic period was marked by high intensity use and great growth in occupation in the region, especially along major rivers. Villages were being reused, populations were increasing in size, ceremonial areas were being developed, and long distance trading occurred.

Great Basin: As described in Giambastiani and Sprengeler (2010), human occupation of the arid west began as far back as 12,000-10,000 B.P. Artifacts from 11,000 and 6,500 B.P. indicate high residential mobility and a focus on the procurement of small game rather than large mammals. From 7,500 to 4,000 B.P. hand stones and milling stones were much more abundant. In eastern California and the Mojave Desert, population densities remained low and there was a shift toward more use of vegetation, though hunting remained focused on small game. The remainder of the Great Basin prehistoric period reflects a wide range of temporal and spatial variation in human adaptive strategies. Land use strategies intensified and the southwestern cultures became more influential on desert inhabitants, leading to long distance trading, diffusion of material cultural and agriculture strategies, and occupation by southwest groups. Large game again became the main focus of hunting, though use of vegetation remained the staple of daily subsistence. Residential mobility was seasonal with sites being reused frequently over long periods of time. In some cases there was an even greater trend toward localization.

Southern San Joaquin Valley: In the southern San Joaquin Valley, human occupation may have occurred as early as 11,000 years ago. For several thousands of years, there was a large reliance on hunting mammals. Beginning around 4,000 B.P., the subsistence base expanded to include seed processing as a supplement to foraging for fish and fowl. Intensive occupation of the valley and foothill region may not have occurred until around 4,500 B.P. The latest period of occupation from 1,500 B.P. until contact with European settlers indicates greater reliance on acorns and other plant foods as well as trade with the central coast region and southern California interior (Moratto 1984).

For more information on prehistoric context, see the August 2, 2013 snapshot of the Sequoia National Forest Living Assessment Chapter 13, lines 106-307.

Historic Period

There are at least four identifiable ethno-linguistic groups whose traditional territories are now within the Sequoia National Forest: Western Mono, Yokut, Kawaisuu, and Tubatulabal. For more information on ethnography, see the August 2, 2013 snapshot of the Sequoia National Forest Living Assessment Chapter 13, lines 308-351. These broad ethnolinguistic groups are further divided into tribal groups and tribelets. At least six federally recognized Native American tribes plus more than fifteen federally non-recognized tribes claim ancestral territory within or immediately adjacent to the Sequoia National Forest. Archaeological and linguistic evidence suggest some groups have been in place on the forest for at least 3,000 years along major trade corridors. They facilitated trade across Native American trade networks that spanned thousands of miles across the entire West. Kennedy Meadows on the Inyo National Forest is a key trading trail juncture, as is the entire Kern River Corridor linking tribes from the interior basins of the west with the California coast.

Most of the indigenous tribes in and adjacent to the Sequoia National Forest maintained their forest presence, although in most cases, they are now centered on lands immediately adjacent to the forest's boundaries. For example, the Sequoia National Forest shares 25 miles of common boundary with the Tule River Indian Reservation. Tribal community centers for the unrecognized tribes of Tubatulabal, Dunlap Band of Mono, and others lie within ten miles of the forest's boundaries. They were not geographically displaced to the extent witnessed on other national forests. Close proximity and continuity of Native American use and occupation has resulted in important consultative relationships and a diverse array of ethnographic and traditional cultural resources from the historic period.

Physically, the most significant historic event that changed conditions on the forest was mining. Early placer and lode mining operations changed entire landscapes, particularly in the southern half of the forest. In the years immediately following the Gold Rush, rumors of gold in the southern Sierra were commonplace. In 1854, gold was discovered In the Kern River, triggering what was arguably the last gasp of the California Gold Rush (Kelly 2012). As the initial excitement began to wane at the epicenter of the Kern River discovery, prospectors began to fan out across the southern Sierra looking for the next big thing. The longevity of the Kern Valley mining industry was a product of these prospectors. In the late 1860s industrial methods and new technology began to be applied in many mining districts of the region. In later years and with the advent of more efficient methods of milling, the detritus of earlier mining operations were themselves perceived as valuable niches. In 1892, one of the nation's first cyanide plants was installed at the Bright Star Mine in the Piutes to treat tailings. However, highly capitalized industrial approaches were not always the key to success. The mining industry often went boom or bust in inverse proportion to the national economy. During periods of financial crisis, the mining industry of the region tended to boom as investors put their money into more traditional safe havens (Kelly 2013). Periods of war also drove the mining industry. The growth of the Cove and Clear Creek mining district, for example, was at least partially the result of the southern Sierra Nevada being perceived as a safe haven for southern sympathizers. In the 20th century, the mining of strategic metals such as tungsten was encouraged by wartime government subsidies. With the expiration of Public Law 206 in 1956, the price of tungsten crashed and the mining industry of the southern Sierra Nevada largely came to a close.

Major changes also occurred as a result of logging, hydroelectric power generation systems, and agricultural water and flood control systems built on the forest that impacted entire watersheds. Hume Lake and Lake Isabella are the two largest reservoirs on the forest. Government management of the forest stretches back into the earliest history of the American environmental movement, which saw such figures as John Muir and the early Sierra Club at work to promote the protection of the "big trees." The work of these early environmentalists ultimately affected land management practices across the entire globe. This episode of early environmental protection on the Sequoia National Forest is considered a data gap in the understanding of historic events connected to logging and governmental protection of giant sequoia groves on the forest.

The Sequoia National Forest was established in 1908, and subsequent land management activities dramatically affected the appearance of the landscape by suppressing fires, managing timber removal, consolidating land ownership, and establishing a framework for rotational grazing of livestock throughout the forest. The Forest Service also encouraged recreational use of forest lands by permitting a wide array of activities to private concessionaires. Services offered to visiting tourists included campgrounds, dispersed camping, resorts that ranged from rustic to luxurious, fishing and hunting events, off-highway vehicle routes, as well as the offering of permitted tracts and lots for the building of recreation residences and rental cabins. The nature and type of recreational services offered on the forest has changed dramatically over the years as the tastes and interests of the visiting public changed. Increased demand for these services has escalated dramatically in recent years and is tied most closely to population growth in California, particularly in urban centers such as Los Angeles and San Francisco.

For more details on the historical context of the Sequoia National Forest, see the August 2, 2013 snapshot of the Sequoia National Forest Living Assessment Chapter 13, lines 506-676.

Cultural and Historic Resources Present in the Plan Area

Cultural resources are defined by the National Historic Preservation Act (NHPA) and by Forest Service Manual (FSM) direction as:

> an object or definite location of human activity, occupation, or use identifiable through field survey, historical documentation, or oral evidence. Cultural resources are prehistoric, historic,

archaeological, or architectural sites, structures, places, or objects and traditional cultural properties (FSM 2300, Section 2360).

The Sequoia National Forest has 2,695 known cultural resources sites that it manages. There are 1,578 Native American archeological sites, which comprise 59 percent of all known cultural resource sites, with the predominant components bedrock milling features and lithic scatters. Known historic sites associated with mining, logging, ranching, hydroelectric infrastructure, and the Forest Service total 474. There are 82 multi-component resources, referring to those with both Native American archaeological and historic period cultural material and features. Of the total known cultural resource sites in the plan area, 561 have not been identified and classified, which is 21 percent of all known cultural resources.

There are 114 cultural resource sites that have been determined to be eligible for inclusion in the NRHP. One site is listed in the NRHP. 148 sites and one district have been determined to be ineligible for inclusion. One cultural resource site has been determined to be eligible for inclusions into the NRHP as a traditional cultural property (TCP).

Native American ethnographic resources are not tracked in the centralized Forest Service database. These locations represent places that manifest one or more attributes of natural resource extraction, spiritual significance, or social and religious ceremonial activity. Their locations are frequently guarded secrets of the tribal community and considered confidential. Historic sites, such as an archaeological site may also have cultural importance such as a sacred site or TCP. The Sequoia National Forest is currently assessing known ethnographic information. There is a rich and diverse array of ethnographic resources across the forest, and many of these are associated with several tribes and are highly sensitive.

Only 30 percent of the forest has been inventoried for cultural resource sites. This survey coverage is uneven with most work focused in areas of recreational and hydroelectric development, in addition to timber harvest areas. Based on known sites, the forest developed a sensitivity model and the predicted cultural resource site density is about 2.5 sites per 100 acres, although site densities may vary greatly from one area to another. The potential number of cultural resources located in the plan area is estimated at 10,000.

Condition of Known Cultural and Historic Resources

The National Historic Preservation Act of 1966, as amended (NHPA), identified the responsibilities of federal agencies for historic preservation, and established the process and requirements for evaluating significance of cultural resources. Additionally, it directed the Secretary of the Department of the Interior to create a National Register of Historic Places (NRHP). Within the guidelines of the NRHP, cultural resources are: eligible for listing on the NRHP, not eligible for listing, or have not been evaluated. Those resources that have not been evaluated are treated as if they are eligible for listing until such time as a formal evaluation is completed.

The July 2, 2013 snapshot of the Sierra National Forest Living Assessment Chapter 13 contains more information on the NHPA and NRHP, which applies to the Sequoia National Forest as well. See lines 418-433. In addition, lines 459-537 contain information regarding other major laws applicable to cultural resources management on the Sequoia National Forest, including the Wild and Scenic River Act of 1968, the Archaeological Resources Protection Act of 1979, and the Native American Grave Protection and Repatriation Act of 1990.

Of known cultural resources, few have been formally evaluated for NRHP eligibility. About 4 percent have been determined to be eligible and 6 percent have been determined to be not eligible for listing. The only property on the forest currently listed on the NRHP is the Walker Pass Pioneer Trail, a national historic landmark. All national historic landmarks are included in the NRHP. Landmarks have been recognized by the Secretary of the Department of the Interior as possessing national significance, whereas properties listed on the NRHP are primarily of state and local significance. The Hume Lake Dam may also qualify as a national historic landmark in the future. Many of the historic hydroelectric power, agricultural water, and flood control systems continue to contribute to the wellbeing of people in California and are concurrently being managed as resources eligible for the NRHP.

An important part of managing cultural resources is identifying their condition. The existing condition of the resource affects its significance under the NHPA, its listing on the NRHP, and identifies what actions need to occur in order to maintain, protect, and interpret it. The NHPA requires that the forest monitor and record the condition of cultural resources in order to ensure their sustainability, and to identify and report adverse effects.

While most historic eras and events are documented, the location, extent, condition, and significance of many of the physical resources reflecting these episodes are unknown. The documentation available for known resources typically lacks the data necessary to determine whether there is potential for impacts to occur prior to project-specific planning, including additional archaeological studies.

The condition and trend of cultural resources is markedly varied across the forest. The Hume Lake and Western Divide Ranger Districts on the northern half of the forest are mostly contained within the Giant Sequoia National Monument. For the most part, cultural resources in the Monument and those behind the adjacent Sequoia and Kings Canyon National Parks entry gates, display an improving condition trend. However, cultural resources are considered to be in a rapidly declining condition on the southern half of the forest on the Kern River Ranger District, where there is a much higher incidence of unregulated dispersed camping and land-disturbing uses. Condition data for the southern half of the forest is spotty and uneven in its reliability. Site condition data is considered to be a major data gap in assessing the status of Sequoia National Forest cultural resources.

A list of activities and natural processes that have impacted cultural resources on the forest can be found in the August 2, 2013 snapshot of the Sequoia National Forest Living Assessment Chapter 13, lines 352-377.

Trends Affecting Condition of Cultural and Historic Resources or Demand for these Resources

Legal compliance with Section 106 of the National Historic Preservation Act (NHPA) has been the focus of cultural resource management activities on the forest. The majority of the work has focused on avoiding direct and indirect physical effects to cultural resources during project implementation, and ensuring confidentiality of their locations. There is little to no qualitative or quantitative information about trends that affect their condition or the demand for their use. However, some general, overarching trends expected to drive change over the next ten to twenty years and beyond are discussed below.

Climate Change and Wildfire

The climate of North America and the southern Sierra Nevada in particular has been warming since the middle of the 19th century, and this trend is expected to continue. Effects on cultural resources vary with the type of resource. Generally, warmer and drier climate regimes produce changes in the vegetation community. Noticeably, conifers tend to die off, while oaks and chaparral species thrive. With the decrease in moisture, there is an increase in wildfire and subsequent erosional activity.

Current management direction to avoid cultural resources during fuels treatments and timber removal activities has led to some unexpected results, namely unnaturally dense vegetation growth on archaeological sites. The exclusion of treatments over the past 30 years has allowed vegetation to grow unchecked on these sites, concentrating fuels on these cultural resources. Continued exclusion of fuel and vegetation treatments will likely result in adverse effects on cultural resources, due to higher intensity burns during wildfires, difficulty accessing areas for traditional gathering and ceremonial activities, and impacts to National Register of Historic Places (NRHP) listing eligibility.

The effects of wildland fire suppression on cultural resources are different from the effects of wildfire. Suppression activities have two components that adversely affect cultural resources. The first component, physical ground disturbance, directly impacts cultural resources by removal and alteration of the physical integrity of design, materials, and setting. These impacts are potentially destructive to all categories of cultural resources. The second component, the application of aerial retardant, introduces potentially toxic chemicals and dyes into the environment. This type of suppression activity primarily impacts plant and water cultural resources, as well as petroglyph/pictograph and sacred sites. Trend analysis for the next 10-20 years indicates an increase in the frequency and severity of wildfire in the Sierra Nevada. Current management direction deals with impacts to cultural resources from suppression activities through an effective system that documents those impacts and mitigates their effect.

Population Growth, Recreation, and Heritage Tourism

Recreational use has both positive and negative effects on cultural resources. Population growth in the central San Joaquin Valley has increased sharply over the past 20 years with no indication of a decline in the future. As the population grows in areas near the Sequoia National Forest, demands for recreation, especially local, low-cost recreation, increases. While cultural resources are impacted by a variety of activities, direct physical damage is generally the most destructive. Many existing recreational facilities are located on or near cultural resources. More people and potentially more infrastructure could lead to adverse effects on cultural resources. As demand for recreation increases and agency budgets decrease, the Sequoia National Forest will be challenged to protect and preserve these non-renewable resources.

On the other hand, as population in the area increases, so has the interest that the public and the tribes have in the management and interpretation of their heritage. Heritage volunteerism is on the rise. This increase is due in part to programs like the California Archaeological Site Stewardship Program, and Passport-in-Time, as well as active engagement with the public and tribes. The concepts of heritage tourism or cultural heritage tourism have developed in response to the recognition that people like to visit heritage sites, and experience different cultures while vacationing. Heritage tourism basically refers to the activity of focusing travel on places where you can experience the people and events of the past. On the Sequoia National Forest, public demand for renting historic cabins is high, and available cabins are fully rented from spring to late fall. Demand for these recreational places increases every year. According to the

Community Heritage Group, national studies indicate that 40 percent of all people visit historic sites when they travel. Demographic data indicate that the aging population is contributing to this trend. Over the last decade, many places around the world have developed programs to attract heritage tourism to their area. The benefits of heritage tourism on local economies, especially economically depressed rural communities, can be significant, since the heritage tourist stays longer, spends more, and is more respectful of the local community. Current management direction does not address public engagement in archaeology or assisting local tribal and governmental partners with heritage tourism. With current management direction, the increased public demand for these experiences may not be met. Additionally, the ability to assist our local partners with economic revitalization of rural communities in the plan area will be diminished.

Illegal Activities

Looting and vandalism is on the rise. While some looting occurs by uninformed and curious members of the public, others are actively conducting excavations on prehistoric sites, and even dismantling historic mines and mills to sell for scrap. The impacts to cultural resources are cumulative and irreparable. Once they are gone, they are gone forever. As the population increases, the number of looting and vandalism incidents has risen. Currently, the Sequoia National Forest is stretched to respond appropriately to the reports of looting incidents. Decreasing budgets and staffing expected over the next 10-20 years will likely exacerbate the problem. Under current management direction, the Sequoia National Forest is expected to have difficulty protecting these resources from criminal activity.

Marijuana cultivation on National Forest System (NFS) lands is increasing. Law enforcement activities tend to concentrate on a few forests at a time, which can successfully limit the activity on targeted forests temporarily. As law enforcement attention shifts to other forests, the growers return to their old plantations. Impacts to cultural resources can result from: ground-disturbing activities that directly affect resources, impacts to plant and animal species that are important cultural resources for Native Californians, and hazardous conditions to access gathering areas and ceremonial places due to safety and health issues. There is little data regarding effects from unauthorized marijuana cultivation on cultural resources. At this time, impacts to cultural resources are not being inventoried, analyzed, and reported. Activities are conducted in secret both by the growers and the law enforcement officers who combat them. The eradication of illegal plantations and their clean up and restoration are exempt undertakings under a programmatic agreement of the Pacific Southwest Region of the Forest Service, and are not subject to review. If this management direction continues, irreparable damage may occur with no documentation or mitigation actions in place.

Contributions the Plan Area Makes to Ecological, Social or Economic Sustainability

Cultural and historic resources cover a vast array of resources that give back to communities both large and small through their use, preservation, and interpretation. Programmatic management strategies allow selective use of various cultural resource types for the greatest public benefit while minimizing overall impacts and leaving a rich cultural heritage for the future.

Cultural uses or cultural and historic resources contribute to sustainability through archaeological deposits that serve as archives of scientific data, documenting past climatic conditions. In addition, these deposits serve as the most important source of scientific data documenting past human adaptations to climate change. This information, along with historical records and traditional ecological knowledge provide a baseline of information valuable for ecological restoration and sustainability projects. Cultural resources expand our knowledge and understanding of history and culture, and help us connect to our heritage. Cultural and historic resources on the Sequoia National Forest not only make scientific contributions to our society, but offer highly personal experiences as well. The realization of the eons of time and generations of people that have passed among the Giants of the Sequoia can be awe inspiring, humbling, and spiritual. The challenges that early Native American traders, pioneer settlers, and miners faced on the mountain trails can lead to interpersonal reflection on ways and means to overcome our own challenges. Spiritual connections can be made that will never be whispered aloud. New and exciting research efforts can create new understandings of history, as well as what may come in the future. Still undiscovered scientific data remain preserved and untouched within deeply stratified archaeological sites.

The heritage resources program for the Sequoia National Forest can play a critical role in enhancing the socioeconomics of local communities by providing employment and income from heritage tourism and recreation. The benefits of heritage tourism on local economies, especially economically depressed rural communities can be significant. Heritage tourists stay longer, spend more, and are more respectful of the local community.

Additionally, cultural resources are a primary component of the Sequoia National Forest’s mandated trust responsibility to Indian tribes. Tribal communities benefit socioeconomically through the use of cultural resources for artisan and craft materials, medicinal purposes, fuel, and traditional foods, and by supporting heritage tourism and recreation. Cultural resources on the Sequoia National Forest also enhance the sustainability of tribal communities by providing opportunities for traditional ceremonies and religious practices that strengthen the community’s sense of place and self. Gathering activities on the forest play an important role in contributing to social, economic, familial, and religious benefits.

Information Gaps

Additional sites, districts, traditional cultural properties, and cultural landscapes likely exist but have yet to be identified and evaluated. In addition, the relatively new understanding about Native Californian resources and their contributions to the historic period will likely change how that context is understood and described in the future with further research and tribal consultation. Significant tribal events, individuals, and themes during this period are not well understood. There is little data about the effects of unauthorized marijuana cultivation on cultural resources because these activities are often dealt with covertly. Finally, many areas of the Sequoia National Forest have not been inventoried for cultural resources, so the number may be underestimated. For those resources that have been identified, limited information is available regarding their condition because the majority of these have not yet been evaluated. In general, the Sequoia National Forest lacks key overview studies to assess cultural and historical resources, including an up-to-date archaeological overview and research design, systematic inventory, assessment of ethnographic resources, historic structures overview, and an administrative history.

Chapter 14: Lands

Important Information Evaluated in this Phase

Land Ownership

The Sequoia National Forest and Giant Sequoia National Monument boundary is encompassed by a total of 1,185,744, acres of which 352,560 acres are within the Giant Sequoia National Monument. In addition, there are 46,684 acres of other ownership, of which 24,245 acres are within the Giant Sequoia National Monument (USDA Forest Service 2012a). Most of the private property located within the Sequoia National Forest and Giant Sequoia National Monument boundary is concentrated around small residential communities. Additional private property is found scattered throughout the forest and supports ranching interests, isolated residences and second homes.

The development of private property located within and adjacent to the Sequoia National Forest and Giant Sequoia National Monument has led to an increased demand for locating and posting of true boundary lines. As funding for landline location has decreased over the last 20 years and private development has increased the number of encroachments has continued to increase as well. There are 507 miles of private property boundary landline within the Sequoia National Forest and Giant Sequoia National Monument. The perimeter of the forest is 599 miles.

The forest has an active land acquisition program based on the forest land acquisition and adjustment plan. The plan emphasizes the acquisition of Giant Sequoia Groves, land within wilderness, land within wild and scenic river corridors and land within riparian areas (USDA Forest Service 1994). For more detailed information see the August 2, 2013 snapshot of the Sequoia National Forest Living Assessment Chapter 14, lines 6-35 and 93-111.

Land Status

On the Sequoia National Forest, there are wilderness areas, wild and scenic rivers, and the Kings River Management Area. These designations play a pivotal role in the determinations of allowable land uses. See Chapter 15 of this assessment for additional information. For more detailed information see the August 2, 2013 snapshot of the Sequoia National Forest Living Assessment Chapter 14, lines 6-35 and 93-111.

Land use zones are identified, described, and designated in the Kern County (KC) and the Tulare County (TC) General Plans. Most of the private land within the Sequoia National Forest is located in Kern County and is subject to the Kern County General Plan. This land is either zoned as “resource” which allows for agriculture, resource reserves, mineral and petroleum development and resource management or “residential” (KC 2004). Federal land is classified as non-jurisdictional and has its own assumptions and guidelines.

The TC General Plan 2030 Update defined new policy and direction providing guidance for coordination and cooperation with other state and federal agencies administering lands uses within Tulare County (TC

2011). The direction was to the greatest extent possible the county will work with agencies, districts, utilities, and Native American tribes to promote consistency with the Tulare County General Plan.

For more detailed information on county planning see the August 2, 2013 snapshot of the Sequoia National Forest Living Assessment Chapter 14, lines 125-298.

Land Uses

On average, the Sequoia National Forest administers 272 non-recreation special use authorization permits annually, encumbering 8,970 acres (USDA Forest Service) 2012b). For a list of these special use authorizations see the August 2, 2013 snapshot of the Sequoia National Forest Living Assessment Chapter 14, lines 300-464.

Access and Access Patterns

The Sequoia National Forest has land that is fragmented, and legal access can be more difficult to obtain because of multiple land ownerships. There are cost share road agreements in place which allow the forest to acquire additional access fairly easily when required. In addition, there are known access points to the forest, both trails and roads, where it would be valuable to obtain permanent legal access for improved recreational and management opportunities. There is a continuing need to acquire legal access on a project-by-project basis. For information on the Sequoia National Forest transportation system see Chapter 11 of this assessment.

The National Forest Transportation System provides access to more than a million national and international visitors every year. These visitors may be participating in motorized recreation or simply utilizing motorized vehicles to access non- motorized recreational activities at trailheads, facilities, destinations, or geographic areas.

Nature, Extent and Role of Existing Conditions and Future Trends

Lands Ownership

As the population increases, there will be more demand for private land inside the boundary of the Sequoia National Forest. This could result in less private land being available for acquisition by the forest.

Land Status and Uses

It is likely that the status and types of uses currently found on the Sequoia National Forest will not change significantly over the foreseeable future.

Access and Access Patterns

For information about the Sequoia National Forest's road and trail systems that provide access throughout the forest, see the transportation section under Chapter 11 of this assessment.

For more detailed information on lands trends see the August 2, 2013 snapshot of the Sequoia National Forest Living Assessment Chapter 14, lines 465-660.

Contributions the Plan Area Makes to Ecological, Social or Economic Sustainability

Access is vital for timber management, fuel treatment, private in-holdings, fire control, utility management, special uses and recreation and harvesting of special forest products. Access is provided on the Sequoia National Forest by the National Forest Transportation System (NFTS). Understanding people's relationships to public lands plays a vital role in travel management planning. Despite apparent differences in opinion, the public, through comments, has revealed a strong connection with public lands on the Sequoia National Forest. Connections are based on generations of use and exploration, as well as traditions that are still in the making.

Forest roads and trails provide access for recreation, fire protection, vegetation management, commercial use, grazing, research, private property use, and insect and disease control. Almost all visitors to the Sequoia National Forest, regardless of the purpose for their visit, use the forest transportation system to reach their destination.

Information Gaps

No information gaps have been identified. Sufficient information exists to perform an assessment related to land ownership, status and access.

Chapter 15: Designated Areas

Important Information Evaluated in this Phase

Designated areas are identified on the Sequoia National Forest because of their unique or special characteristics and are managed with specific management direction. The purposes and types of established designated areas are described in this chapter. Location information for Sequoia National Forest designated areas can be found in the August 2, 2013 snapshot of the Sequoia National Forest Living Assessment Chapter 15.

Current and potentially designated areas on the Sequoia National Forest are listed below.

Statutorily Designated Areas on the Sequoia National Forest:

National Monument - Giant Sequoia National Monument

National Scenic Trail - Pacific Crest National Scenic Trail

National Recreation Trails - Cannell Meadow National Recreation Trail, Jackass Creek National, Recreation Trail, Summit National Recreation Trail

Wild and Scenic Rivers - North Fork and South Fork Kern River, Kings, Middle Fork Kings and South Fork Kings River

Wilderness - Monarch Wilderness, South Sierra Wilderness, Golden Trout Wilderness, Domeland Wilderness, Jennie Lakes Wilderness and Kiavah Wilderness

Administratively Designated Areas on the Sequoia National Forest:

Inventoried Roadless Areas

Scenic Byway - Kings Canyon Scenic Byway

Kings River Special Management Area

Walker Pass National Historic Landmark

Potential Designated Areas that May be Considered:

Eligible Wild and Scenic Rivers - Lower Kern River, North Fork Middle Fork Tule River North Fork Tule River

Suitable Wild and Scenic Rivers - South Fork of the Kern River

Wilderness – Moses Wilderness

Nature, Extent and Role of Existing Conditions and Future Trends

Giant Sequoia National Monument

The Giant Sequoia National Monument (Monument) is located in south-central California and covers 328,315 acres of the Sequoia National Forest.

Created by presidential proclamation on April 15, 2000 the:

> Rich and varied landscape of the Giant Sequoia National Monument holds a diverse array of scientific and historic resources. Magnificent groves of towering giant sequoias, the world's largest trees, are interspersed within a great belt of conifer forest, jeweled with mountain meadows. Bold granitic domes, spires, and plunging gorges texture the landscape (Clinton 2000, p. 24095).

The majority of the Hume Lake and Western Divide Ranger Districts which make up approximately one third of the Sequoia National Forest are in the Monument. The Monument is managed according to direction in the 2012 Giant Sequoia National Monument Management Plan (USDA Forest Service 2012a). Management strategies and objectives focus on protection and management of the objects of interest, restoring and maintaining ecosystems, and providing for visitor enjoyment of the Monument. For a detailed description of the current conditions in the Monument, please refer to pages 159-376 of the Monument FEIS (USDA Forest Service 2012b).

Pacific Crest National Scenic Trail

The Pacific Crest National Scenic Trail (PCT) travels through the Sequoia National Forest for 47 miles, in three segments, with a mile wide trail corridor. The trail travels 22 miles, crossing back and forth on the Inyo National Forest and Sequoia National Forest boundary, mostly in the South Sierra Wilderness, 16 miles through the Scodie Mountains in the Kiavah Wilderness, and nine miles through the Piutes (non-wilderness). The total wilderness mileage is 34 miles. There are seven road crossings, and 11 non-system off highway vehicle route crossings in the Piutes section of the PCT. Managers have not received any reports of incidents or conflicts on the portions of the trail that travel through the Sequoia National Forest.

The Sequoia National Forest is not aware of any current capacity issues. The popularity of long distance trails is growing and there has been an increase in numbers of visitors for through-hike use on the PCT. Forest Service and National Parks Service managers have identified capacity issues related to the John Muir Trail which coincides with the PCT on the Sierra National Forest and Inyo National Forests, and at Yosemite and Sequoia and Kings Canyon National Parks. This trend is expected to continue. The condition of the trail is good as a result of grants and partnerships using volunteers from the PCT Association and High Sierra Volunteer Trail Crew. Volunteer and partnership support for the PCT is expected to continue into the future.

Most of the PCT visual corridor is protected with a visual quality objective of retention or better. The greatest portion of the trail travels through wilderness on the Sequoia National Forest and on adjacent lands. However, in the last ten years wildland fire has played a significant role in the accessibility and scenic experience of the PCT for hikers and equestrians on the forest. Fires on the Sequoia National Forest have become larger, and burn with higher severity in recent years. The Clover Fire of 2012 and the Manter Fire of 2000 are examples of large, high severity burns that have affected the recreation experience on the PCT. Though the PCT itself was not overly impacted by all high severity fires, some of the trails that access the PCT on the Sequoia National Forest were impacted, resulting in many miles of trails closed by fallen dead trees.

The current trends in ecological conditions are expected to continue, including elevated fuel loads with risk of high severity wildfire, loss of meadows with conifer encroachment, and other ecosystem disturbance associated with climate change. More information about these ecological trends can be found in Chapters 1, 2 and 3 of the assessment. For more detailed information on the Pacific Crest Trail see the August 2, 2013 snapshot of the Sequoia National Forest Living Assessment Chapter 15, lines 44- 116.

National Recreational Trails

The attraction of the nine mile long Cannell National Recreation Trail is the tremendous contrast between the lower and higher elevations. Open year round, the trail receives heavy use when the upper elevations are not covered in snow. Forest funds leveraged with state off highway vehicle grants provide for annual maintenance with volunteer and temporary hire trail crews. The trail is managed as a single track trail, classified as semi-developed, and open to pedestrian, bicycle, equestrian and motorcycle traffic.

The three mile Jackass Creek Trail is maintained for pedestrian, equestrian, motorcycle, and bicycle traffic (USDA 2012 INFRA). The trail is heavily used five months of the year until snow closes the road. Forest funds leveraged with state off highway vehicle grants provide for annual maintenance with volunteer and Forest Service trail crews.

The twelve mile Summit National Recreation Trail is maintained for hikers, mountain bikes, equestrians and cross-country skiers. In the designated Giant Sequoia National Monument, off highway vehicle use is prohibited on the trail. The majority of use occurs during the summer.

For more detailed information on national recreation trails see the August 2, 2013 snapshot of the Sequoia National Forest Living Assessment Chapter 15, lines 117-169.

Wild and Scenic Rivers

Before the Sequoia National Forest invites comments on the proposed plan, an inventory of the eligibility of rivers for inclusion in the Wild and Scenic System is required (USDA Forest Service 2012b). This inventory is not required during the assessment. For more detailed information on wild and scenic rivers, see the August 2, 2013 snapshot of the Sequoia National Forest Living Assessment Chapter 15, lines 170-395.

In accordance with the Wild and Scenic Rivers Act of 1968, the Sequoia National Forest conducted an initial screening of streams and rivers on the forest to identify those that had potential for inclusion in the Wild and Scenic Rivers System. This screening discovered six more stream or river segments eligible for Wild and Scenic status.

Water is a major attraction for visitors to the forest (USDA Forest Service 2008a) and visitor use is expected to reflect projected population increases. Competing human demands for water resources include irrigation, household use, hydroelectric power, ground water recharge, and recreation. All of these uses have the potential to affect the quality of the water resource and the ability of the streams to meet wild and scenic river standards.

The Kern and Kings Rivers offer exceptional whitewater recreation opportunities enjoyed by many sectors of the public. Outfitter guides operate on the Kern River through a special use permit program. The fees collected with these permits have been an important funding source for maintaining the recreation experience and are expected to continue to be an important source in the future. The program on the Kings River is managed by the Sierra National Forest. The Tule River and some tributaries of the Kern have been identified for their exceptional whitewater opportunities by the private sector. Because of the rather limited opportunities for whitewater recreation, the recreation demand is projected to continue and increase into the future.

Whitewater opportunities are dependent on the amount of snowpack and the rate at which it melts. Climate change will influence the amount of precipitation that falls as snow and contributes to the snow pack. As temperatures rise less precipitation falls as snow and is stored for the more gradual release needed to sustain white water conditions. Drought has also had negative effects on the availability of quality whitewater conditions, as well as other water-based recreation activities, on these wild and scenic rivers.

North Fork and South Fork Kern River

In November, 1987, segments 2, 3 and 4 of the North Fork and South Fork of the Kern River were designated as wild and scenic. For more detailed information describing the North Fork and South Fork of the Kern River wild and scenic river segments see the August 2, 2013 snapshot of the Sequoia National Forest Living Assessment Chapter 15, lines 171-281.

The identified outstandingly remarkable values of the North Fork of the Kern River segments (USDA 1985 and 1989a) are:

- Recreation – segments 2, 3 and 4
- Geology - segment 2
- Wildlife – segment 4
- Fisheries - segment 2
- Vegetation - segment 2
- Cultural and Historic Landscape - - segment 2
- Scenic – segments 2, 3 and 4

North Fork Kern segment 4 – Over the last twenty years, resource effects from recreational activity has escalated because there are no limits on the number of guests and the number of vehicles at locations where visitors are allowed to camp outside of developed campgrounds. This has resulted in effects to vegetation, sanitation issues, and loss of habitat. Overcrowding, congested parking and poor sanitation practices in the Upper Kern River corridor demonstrate the need for more intensive management of this area. The Kern River Ranger District has developed an Upper Kern River Action Plan to address resource impacts, public concerns, and current policies to strategically regain management control within the river corridor (USDA 2010).

The identified outstandingly remarkable values of the South Fork of the Kern River segments (USDA 1988b) are:

- Recreation – segments 2 and 4
- Cultural and Historic Landscape - – segments 2, 3 and 4
- Scenic – segments 2 and 4

South Fork Kern Segment 3 - In the past five years there has been an increase in private development in the Kennedy Meadows area. The area is characterized by the predominance of smaller parcels with clustered residential development.

Kings and South Fork Kings River

In November 1987, the Kings (segments 1 and 1A), and the Kings South Fork (segment 2) Rivers were designated as wild and scenic. For more detailed information on Kings, and the Kings South Fork Rivers Wild and Scenic River segments see the August 2, 2013 snapshot of the Sequoia National Forest Living Assessment Chapter 15, lines 282-395.

The identified outstandingly remarkable values of Kings and Kings South Fork Rivers (USDA 1988b) are:

- Geology – Kings River segment 2; South Fork Kings segments 1 and 1A

- Wildlife - Kings River segment 2; South Fork Kings segments 1 and 1A
- Recreation- Kings River segment 2; South Fork Kings segment 1A
- Cultural/historical benefits (Kings River segment 2; South Fork Kings segment 1A
- Scenic - Kings River segment 2; South Fork Kings segments 1 and 1A
- Fisheries - Kings River segment 2; South Fork Kings segments 1 and 1A

Kings River segment 2 - Scenery is in excellent condition and there is an addition of a new interpretive sign at Junction View Overlook. Current condition of the fisheries and geology is unknown at this time. Recreational value is moderate with Yucca Point trail not maintained for the last three to four years.

South Fork Kings River segment 1 - Current condition of the scenery is good, condition of other values is unknown.

South Fork Kings River segment 1 - Current condition of the recreational value is in good condition. These include camping at Convict Flat, picnicking at Grizzly Falls, cave tours at Boyden Cavern, and trailhead parking at Deer Cove. Current condition of other values is unknown.

Eligible Rivers

Kings River

Segments 2, 3 and 4 of the Kings River have been determined to be eligible for wild and scenic river designation. The suitability study is pending. The identified outstandingly remarkable values of Kings River eligible segments (USDA 1991a) are:

- Geology –segments 3 and 4
- Wildlife - segments 3, 4 and 5
- Recreation- segments 3, 4 and 5
- Cultural/historical benefits - segments 3, 4 and 5
- Scenic - segment 3, 4 and 5
- Fisheries - segments 3, 4 and 5
- Botany - segment 3
- Science and Education segments 3 and 4

For more detailed information on eligible Kings River W&SR segments see the August 2, 2013 snapshot of the Sequoia National Forest Living Assessment Chapter 15, lines 329-395.

Lower Kern River

Segments 1, 2 and 3 (30.8 miles) of the Lower Kern River have been determined to be eligible for wild and scenic river designation. The suitability study is pending. The identified outstandingly remarkable values of Kings River eligible segments (USDA 1994) are:

- Wildlife –segments 1, 2 and 3
- Recreation –segments 1, 2 and 3
- Scenic –segments 1, 2 and 3

For more detailed information on eligible Lower Kern River wild and scenic river segments see the August 2, 2013 snapshot of the Sequoia National Forest Living Assessment Chapter 15, lines 396-476.

Little Kern Segment

The Little Kern segment has been determined to be eligible for designation. The suitability study is pending. The outstandingly remarkable values of this segment are recreation and fisheries.

North Fork Middle Fork Tule River

The North Fork Middle Fork Tule River has been determined to be eligible for designation. The suitability study is pending. The outstandingly remarkable value of this river is ecological.

North Fork Tule River

The North Fork Tule River has been determined to be eligible for designation. The suitability study is pending. The outstandingly remarkable value of this river is recreation.

For more detailed information on suitable wild and scenic rivers see the August 2, 2013 snapshot of the Sequoia National Forest Living Assessment Chapter 15, lines 477-522.

Suitable River

South Fork of the Kern River

One mile of the South Fork of the Kern River (segment 1) is suitable for designation. The outstandingly remarkable values of this segment are scenic, vegetation and wilderness (USDA 1991b). The suitability study has been completed.

Updated Wild and Scenic River Eligibility Inventory

Reaches of the following rivers are free-flowing and all offer spectacular and remote paddling adventures that are extremely rare in the lower 48 states and warrant serious consideration for their eligibility.

- Middle Fork Tule
- Mill Flat Creek
- Kern River
- Brush Creek
- Dry Meadow Creek
- King's River

Wilderness

Designated wilderness comprises 26 percent of the Sequoia National Forest, for a total of 309,299 wilderness acres. There are six designated wilderness areas, either in whole or part, within the administrative boundary of the Sequoia National Forest. The geographic area for these wildernesses ranges from 10,289 to 106,683 acres. Before the Sequoia National Forest invites comments on the proposed plan, an inventory and evaluation is required for wilderness (USDA 2012a). This inventory and evaluation is not required during the assessment.

Wilderness on the Sequoia National Forest

Wilderness	Total Acres	Acres on Sequoia National Forest
South Sierra	63,000	28,664
Golden Trout	303,287	106,683
Domeland	133,160	94,544

Wilderness	Total Acres	Acres on Sequoia National Forest
Jennie Lakes	10,289	10,289
Monarch	44,900	23,900
Kiavah	81,247	45,219
Total Acres of Wilderness		309,299
Acres in the Sequoia National Forest		1,193,315

Wilderness Trends

Wilderness use: Wilderness use is generally light in the Sequoia National Forest (USDA Forest Service 2006, NVUM).

***Fire suppression*:** Fire is a primary driver of the condition of the untrammeled aspect of wilderness character. Suppression of lightning fires in wilderness continues to negatively affect wilderness character by manipulating fire-adapted ecosystems. Allowing fires to burn in wilderness (wildfires managed primarily to meet resource benefits) where risks are acceptable will improve wilderness character. In the summer of 2011, the more than 20,000-acre Lion Fire was a wildfire managed primarily to meet resource benefits in the Golden Trout Wilderness.

***Fish stocking*:** Fish stocking continues in some wilderness lakes. The continued presence of non-native fish, especially in historically fishless lakes, degrades the untrammeled and natural elements of wilderness character. Regionally, a trend toward less stocking may benefit wilderness character. Special fishing regulations further protect native fish populations.

***Black bear food conditioning*:** Black bears are active on the forest but no issues have been reported. A forest order is in place requiring proper food storage for the Hume Lake Ranger District, and people are encouraged to use food storage containers in the wilderness. Continued efforts are necessary to ensure that bears do not become a problem in the future. There is no conclusive information on local trends.

***Cattle grazing*:** The current trend is toward consistent and stable grazing in wilderness.

***Air quality*:** Monitoring is done on visibility and atmospheric deposition of pollutants in aquatic and terrestrial ecosystems to determine long term trends. See Chapter 2 of this assessment for information on wilderness air quality.

***Intensity of Wilderness Use around Water*:** People are drawn to water. Wilderness areas that include meadows, streams and lakes receive the most intensive use, sometimes at unsustainable intensity. If additional wilderness is added to the Sequoia National Forest, consideration should be given to adding landscapes with water to spread water-related wilderness use across a larger foot print (USDA 2013).

Monarch Wilderness

Management challenges for the Monarch Wilderness include wildfire aggravated by extremely steep slopes and protecting the wilderness character. There have been recent efforts to suppress lightning caused fires in wilderness including the use of non-traditional tools to fall and buck trees. Recent wilderness patrols have identified a user-created horse corral in the Wildman Meadow area. Visitation is very light because of the steep terrain. Stewardship partners are essential to maintain or improve the wilderness character in the Monarch Wilderness.

This wilderness does not meet the minimum stewardship levels as set by the 10 Year Wilderness Challenge (YWC). The 10 YWC score for FY2012 is 40 out of 100. It is anticipated that it may meet the minimum score by 2014.

For more detailed information on the Monarch Wilderness see the August 2, 2013 snapshot of the Sequoia National Forest Living Assessment Chapter 15, lines 585-633.

South Sierra Wilderness

The condition of trails is poor in this wilderness area; however, trail conditions are improving with the use of partnerships and volunteers. In the winter of 2012, winds blew hundreds of trees across trails. This wilderness continues to receive low use and this trend is expected to continue, based on staff observations.

Management challenges for the South Sierra Wilderness include vehicles in the wilderness and human caused erosion lowering of the water table and leading to vegetation changes.

This wilderness provides outstanding opportunities for solitude. Recreation use is very light. The Pacific Crest Trail attracts some hikers and equestrians. Day use activities such as hiking, fishing, and equestrian use account for the majority of the visitation. Deer hunting is popular in the fall. There is limited cross country skiing in the winter. Campsites are not obvious and tend to be found around the Pacific Crest Trail or meadow edges.

The South Sierra Wilderness does not meet the minimum stewardship standard defined in the 10-Year Wilderness Stewardship Challenge.

For more detailed information on the South Sierra Wilderness see the August 2, 2013 snapshot of the Sequoia National Forest Living Assessment Chapter 15, lines 634-670.

Golden Trout Wilderness

Management challenges for the Golden Trout Wilderness include maintaining the approximately one hundred and fifty miles of trail, maintaining administrative facilities include guard stations, public pastures, pack stations, and some pit toilets in areas of heavy use. Private inholdings, helicopter traffic, military training flights, cattle grazing and helicopter traffic to Pecks Canyon interrupts the solitude of the wilderness. Cattle grazing, cow camps, corrals, fenced pastures and drift fences are evident.

The Golden Trout Wilderness does not meet the minimum stewardship standard defined in the 10-Year Wilderness Stewardship Challenge.

The Lion Fire in 2011 (wildfire managed primarily to meet resource benefits) and the George Fire in 2012 (wildfire managed primarily to meet resource benefits) helped improve fuel conditions in parts of the Golden Trout Wilderness. The condition of trails is poor in this wilderness area; however, trail conditions are improving with the use of partnerships and volunteers. Use is low in most of the Golden Trout Wilderness, with some concentrated use along the Kern and Little Kern Rivers, based on staff observations in 2013.

For more detailed information on the Golden Trout Wilderness see the August 2, 2013 snapshot of the Sequoia National Forest Living Assessment Chapter 15, lines 671- 699.

Domeland Wilderness

Management challenges for the Domeland Wilderness include wildfire and trail management. The FY2000 Manter Fire burned over the wilderness. The FY 2002 McNally Fire burned a smaller area in the wilderness. The heaviest use originates out of Big Meadow trailheads to Manter Meadow.

This wilderness does not meet the minimum stewardship levels as set by the 10 Year Wilderness Challenge (YWC). The 10 YWC score for FY2012 is 40 out of 100. It is anticipated that it may meet the minimum score by 2014.

Trail conditions in this wilderness are fair and improving with the help of volunteers. Use is low. The Manter Fire in 2000 burned 60 to 70 percent of the wilderness, and killed large areas of trees. Thirteen years later, more trees fall across and block the trails each year, based on staff observations in 2013.

For more detailed information on the Domeland Wilderness see the August 2, 2013 snapshot of the Sequoia National Forest Living Assessment Chapter 15, lines 700-728.

Jennie Lakes Wilderness

Wilderness use is generally light in the Sequoia National Forest (NVUM 2006). However, the close association with the national parks makes Jennie Lakes Wilderness one of the heaviest used wildernesses on the Sequoia National Forest. Day use is heaviest around lakes.

This wilderness does not meet the minimum stewardship levels as set by the 10 YWC. The 10 YWC score for FY2012 is 52 out of 100. It is anticipated that it may meet the minimum score by 2014.

For more detailed information on the Jennie Lakes Wilderness see the August 2, 2013 snapshot of the Sequoia National Forest Living Assessment Chapter 15, lines 729-768.

Kiavah Wilderness

Throughout the greater part of the Scodie Mountains, human influence has not affected the ecological process or natural integrity of the area (USDA 1988b). The Scodies provide many opportunities for solitude and primitive recreation. Recreation use is estimated to be low compared with other areas on the forest primarily because of the arid conditions. Hunting and through foot traffic on the Pacific Crest Trail are predominate uses (USDA 1988b).

This wilderness does not meet the minimum stewardship levels as set by the 10 YWC. The 10 YWC score for FY2012 is 52. It is anticipated that it may meet the minimum score by 2014.

The Pacific Crest Trail, where it runs through the Kiavah Wilderness, is in good condition, and the Scodies Trail is in fair condition. The McGyver Jeep Trail is maintained by volunteers. There is some conflict with users of the Pacific Crest Trail, but any off-highway vehicle (OHV) encroachment, which increases during hunting season, is limited by vegetation. The Jack Fire in 1989 or 1992 was a stand-replacing wildfire, and the previous pinyon pine community has been replaced with early seral sagebrush. The primary use of the area surrounding the wilderness is OHV. Sage Canyon and Cow Haven are, two old mining access roads, are important to the OHV community and hunters. In Horse Canyon, OHV users are known to bypass signs and create hill climbs intruding into the wilderness.

For more detailed information on the Kiavah Wilderness see the August 2, 2013 snapshot of the Sequoia National Forest Living Assessment Chapter 15, lines 769-792.

Inventoried Roadless Areas

On the Sequoia National Forest 346,611 acres or 29 percent of the Sequoia National Forest remain as inventoried roadless area. Of the original 509,174 acres of inventoried roadless areas, 137,697 acres have been designated as wilderness (Sequoia National Forest GIS Database 2012).

A portion of the Moses Inventoried Roadless Area (about 15,100 acres) will be recommended for inclusion in the National Wilderness Preservation System, as the Moses Wilderness. It will be managed as a proposed wilderness while Congress considers its designation (USDA 2012a).

Other roadless areas include Agnew (half of the original roadless area was designated in the Monarch Wilderness), Black Mountain, Cannell, Chico, Cypress, Dennison Peak, Domeland Addition (some added to Domeland Wilderness), Domeland Additions II (most added to the Domeland Wilderness), Greenhorn Creek, Jennie Lakes (most designated in the Jennie Lakes Wilderness), Lyon Ridge, Mill Creek, Monarch (most designated in the Monarch Wilderness), Moses (a little designated in the Golden Trout Wilderness, some is proposed for designation as wilderness in the Monument Plan), Oat Mountain, Rincon (some designated in the Golden Trout Wilderness), Scodies (mostly designated in the Kiavah Wilderness), and Woolstaff (Table and map generated from SQF GIS Data Base, 2012).

Sierra Forest Legacy has identified additional Sequoia National Forest lands that they feel qualify for wilderness designation in their 2011 Citizens Wilderness Inventory (Britting et al. 2012). There needs to be a comparison of the Citizens Wilderness Inventory and RARE II completed.

For more detailed information on inventoried roadless areas see the August 2, 2013 snapshot of the Sequoia National Forest Living Assessment Chapter 15, lines 794-820.

Research Natural Areas

Research Natural Areas (RNAs) are National Forest System (NFS) and other public lands permanently protected to maintain biological diversity and provide ecological baseline data, education and research. Only non-manipulative research is allowed within the RNAs. RNAs have been selected based on vegetation target elements. Three RNAs have been established on the Sequoia National Forest and one other is a candidate for establishment (Cheng 2004).

The 1,465 acre established Church Dome RNA is located in the South Sierra Wilderness. It represents eastside Jeffrey pine, desert pinyon woodland and rock outcrop vegetation types. This RNA has granite and extrusive igneous (basalt) lithology. According to Cheng (2004, p. 60):

> This area receives little recreation impact. The trail through the western portion of the RNA has light use. There is evidence of past grazing use but no current grazing occurs and there appears to be no habitat alternation as a result of past usage. Forest litter is minimal and the need for controlled burning is low.

The 2,131 acre Long Canyon RNA is in the northern Piute Mountains. This RNA has metamorphic schist and marble lithology and preserves Piute cypress and desert chaparral vegetation communities. According to Cheng (2004, p.181):

> Despite proximity to human development the candidate RNA has experienced little impact. One dirt road enters the site to the north of the region. A few campsites and a cluster of old bee boxes are associated with the road. The westernmost branch of the road ends at a mining excavation in metamorphic rock, but appears not to be in use. Dirt bikes and other off-highway vehicles appear to have used the road and the main trail.
>
> Cattle grazing is limited to the annual grassland with little or no impact on the shrubs of the adjacent foothill pine woodland or the vegetation along the streambed. The few cattle seen were near the northern boundary where a fence delineates the site. However the current condition of the fence allows the cattle to cross easily.

The 960 acre Moses Mountain RNA is within the Golden Trout Wilderness. It contains montane meadows and parts of the Upper and Middle Tule Giant Sequoia Groves. This RNA is underlain by soils derived from the meta-sedimentary Wishon/Tule roof pendent. According to Cheng (2004, p.202):

> Despite heavy use of a trail through the area and several regularly used campsites, human impact on most of the area is light. Areas around campsites are regularly lightly grazed by pack animals, but heavy trampling is restricted to immediate areas of trails and campsites.

The 1,603 acre South Mountaineer Creek RNA is a candidate area in the Golden Trout Wilderness. This high elevation RNA represents red fir and subalpine forest, and montane meadows. According to Cheng (2004, p.269):

> A few campsites are located near the South Mountaineer Creek. Aside from these sites, little recreation impact was noted in the site. The wet meadows are largely undisturbed and show no noticeable signs of grazing. Clear-cut clocks (cut over the past 15 – 20 years) border the southeast side of the site but do not affect the South Mountaineer Creek drainage.

Botanical Areas

Sequoia National Forest lands which have high concentrations of rare and endemic plants (usually associated with atypical geology and unusual soil types) are designated as Botanical Areas (BAs).

The 780 acre Baker Point BA is a granite bedrock peak with sweeping views, many rare plants, and an historic lookout tower.

The 4,190 acre Freeman Creek Grove BA contains the Freeman Creek Giant Sequoia Grove, the easternmost grove of giant sequoias and considered to be among the most recently established. Part of the grove is underlain by a three million year old volcanic basalt flow.

The 500 acre Slate Mountain BA is unique because of its abundance of four different rare plants. It sits on the rocky northern summit of Slate Mountain and is comprised of pre-cretaceous metamorphic and meta-sedimentary rocks surrounded by granitic rocks. Nearly 95 percent of the total population of Twisselmann's buckwheat occurs on Slate Mountain.

The 446 acre Bald Mountain BA is geologically unique and is underlain by pre-cretaceous meta-sedimentary rocks (made up of layered rock deposits). This mountain not only offers one of the best views in the southern Sierra Nevada, but also an opportunity to experience the unique plant assemblages that occur here.

The 860 acre Ernest C. Twisselmann BA is located on the Kern Plateau. It is named after a local rancher and lay botanist whose herbarium is still maintained in the Kern River Ranger District office. The area is characterized by a subalpine coniferous ecosystem with a diverse mix of foxtail, limber, western white, Jeffrey, and lodgepole pine, and red and white fir. Many plants found here are in their southernmost location in the Sierra Nevada.

The 270 acre Inspiration Point BA is located in the northern Piute Mountains and offers spectacular views of the Lake Isabella Reservoir, Kern River Valley, Greenhorn Mountains, and Kern Plateau. The common rock types are metamorphic with mafic schist and gneiss and a large prominent limestone ridge. Floristics is very unusual in this BA with limber pine (a subalpine tree) growing with pinyon pine.

The 860 acre Bodfish Piute Cypress BA is also located in the Piute Mountains. It is underlain by soils derived from mafic igneous gabbro and hornfels. This BA supports the largest grove of the endemic Piute cypress, which is only found in 13 small groves surrounding Lake Isabella.

Geological Areas

The 40 acre Packsaddle Cave Geological Area is located approximately 15 miles north of Kernville, California, and was designated for its special geologic features. The cave consists of a large room-like passage, with minor rooms at the rear. The Kern Canyon Fault, recently determined to be an active fault, runs through this geological area.

The 3,500 acre Windy Gulch Geological Area is located in the Giant Sequoia National Monument and contains a number of outstanding formations, including caves and marble roof pendants. Mesozoic granitic rocks are the dominant rock type and consist of several plutons approximately 100 million years old. The metamorphic rocks are known as the Kings Terrain. The most extensive of these are the Lower Kings River, Kaweah River, and Tule River roof pendants. The Lower Kings River roof pendant includes the Boyden Cave roof pendant, whose marble contains several caves including Boyden Cave and Church Cave.

Forest Service Scenic Byways

Kings Canyon Scenic Byway was designated in 1990 as a National Forest Scenic Byway for scenic beauty and recreational value. The byway is popular year around; however the majority of the use is in the summer months. The road into the canyon from the Hume Lake turnoff is closed during the winter months.

This road receives high visitor use because it is the only access to Cedar Grove in Kings Canyon National Park, and use is expected to increase in the future. The road condition is good and more interpretive signs will be installed in 2014. Graffiti and vandalism have increased I the last several years, based on staff observation in 2013.

For more detailed information on scenic byways see the August 2, 2013 snapshot of the Sequoia National Forest Living Assessment Chapter 15, lines 823-839.

Historical Landmarks

The Walker Pass National Historic Landmark includes approximately 111 acres of federal lands on the Sequoia National Forest, as well as the Bureau of Land Management Caliente and Ridgecrest Resource Areas. Walker Pass was designated a national register property and national historic landmark on July 4, 1961. Walker Pass is named after Joseph Rutherford Walker and his use of the pass for actions that contributed significantly to the exploration and settlement of California by the United States of America in the years 1834, 1843, and 1845.

Moses Mountain is a candidate for national landmark designation. The Sequoia National Forest is coordinating with the National Park Service in on site landmark evaluation studies.

Kings River Special Management Area

The 49,000 acre Kings River Special Management Area (KRSMA) includes five miles of wild and scenic river (segment 2), plus an additional 13 miles of the river (segment 1) that was not designated Wild and Scenic. The special management area falls in two national forests, the Sequoia National Forest and the Sierra National Forest. The portion of the KRSMA on the Sequoia National Forest is bounded on the north by the Kings River and within the Giant Sequoia National Monument. The area is generally steep with brush and grass covered canyons, 1,000 feet to 5,000 feet in elevation, not very accessible, and provides great opportunities for solitude. Native American use and needs may preclude some interpretation. Existing off highway vehicle routes are not passable. Management challenges include risks associated with wildfire aggravated by extremely steep slopes.

The Kings River Special Management Area receives low use in most areas, but moderate use along the river and on the trail to the Boole Tree. This trend is expected to continue, based on staff observation 2013. The Kings River offers whitewater recreation opportunities. The Sierra National Forest manages the boating permits for outfitters and guides. The demand for recreation opportunities associated with the river is expected to continue and expand into the future.

For more detailed information on scenic byways see the August 2, 2013 snapshot of the Sequoia National Forest Living Assessment Chapter 15, lines 843-862.

Contributions the Plan Area Makes to Ecological, Social or Economic Sustainability

Areas have been designated on the Sequoia National Forest to protect and utilize their special attributes. There are specific land types or ecosystems present in the plan area that prior to designation: 1) were not represented or were minimally represented within the wilderness system or system of research natural areas; 2) had outstanding resources; 3) provided opportunities to highlight unique recreational or scenic areas in the plan area to provide for sustainable recreation opportunities; 4) provided a unique opportunity to highlight specific educational, historic, cultural, or research opportunities; or 5) were lands with known important ecological roles. Land areas that met these criteria have been designated on the Sequoia National Forest.

Trail systems, including the Pacific Crest National Scenic Trail and three other national recreation trails provide many social and economic contributions. Trails are an invitation into nature allowing the appreciation of wild scenery. Forest landscapes inspire awe for their immensity, timelessness, and self-organized complexity. Trails through the Sequoia National Forest are a refuge from industrialized civilization and its sights, sounds, and smells moving at a more natural pace that allows all our senses to work. Solitude and detachment from routine social pressures and distractions provide the setting for inward reflection and self-discovery.

Hiking allows a freedom of unconfined recreation along with a sense of belonging to the natural whole. Hiking can present a physical challenge leading to a sense of personal accomplishment. Experiencing the Sequoia National Forest can lead to citizen ownership of and investment in resources of national significance.

As populations increase the sustainability of trails may be in question. While trail maintenance funding is flat or declining, partnerships have been an important source of trail maintenance. The Sequoia National Forest's ability to engage the public and increase its partnerships will be a factor in determining the sustainability of these important social outlets.

The specific social, economic and ecological benefits of wild and scenic rivers provide managers with tools to protect free-flowing condition, protect and enhance of water quality and values, and, promote economic development, tourism, and recreational use. Wild and scenic rivers enhance social values by encouraging management that crosses political boundaries in recognition that all activities in the watershed may affect water quality, fish, wildlife, recreation and other values, as well as by promoting public participation and partnerships to conserve river values.

Additionally wild and scenic rivers are an increasingly important resource in a time of significant climate change as they secure environmental flows through the federal reserved water right created to protect values. They also allow the application of climate forecasting and design strategies to protect river-related values and in-corridor development from the anticipated effects of reduced or exacerbated flows.

Wilderness areas contribute significantly to our nation's social, economic and ecological health and well-being. The benefits these areas provide are as diverse as the areas themselves.

Wilderness areas are important sources of clean water and air. While the benefits of wilderness transcend boundaries, they are threatened by human activities outside wilderness.

Wildlife and plant communities find high quality habitat with wilderness. Wilderness designations also provide for natural processes, including disturbances like fire, which are important to wildlife and plant communities. Wilderness is threatened by the introduction of non-native species, pollutants, and the suppression of natural processes.

The legacy of wilderness is passed on from generation to generation. Some people take once-in-a-lifetime trips that deeply affect them. Some people visit regularly, and are routinely refreshed in the wilderness. Some people will never visit wilderness yet value knowing that these places exist. Failure to preserve these areas limits the future generations' inheritance and quality of life.

Wilderness was created for the use and enjoyment of the American people. Yearly, over 12 million people visit wilderness areas to hike, ride horses, hunt, fish, ski, float the rivers, take pictures, and stargaze. Many people who visit wilderness are inspired and humbled by the feeling of being part of something larger than themselves. Wilderness is a haven for self-discovery and rejuvenation. Wilderness areas are closed to motorized vehicles and mechanical forms of transportation, including mountain bikes. Trespass by these types of transportation threatens the solitude and primitive recreational opportunities for which they are designated (Bureau of Land Management 2013).

Twenty-six percent of the Sequoia National Forest is wilderness. Staffing of wilderness rangers has been static and in some cases has declined. Insufficient monitoring has been done to fully characterize the sustainability of wilderness. The Wilderness Stewardship Challenge scorecard indicates that four wildernesses on the Sequoia National Forest may be of some concern as to the sustainability of aspects of wilderness character.

Inventoried roadless areas preserve lands that could be suitable for conservation as wilderness or other non-standard protections in a roadless condition. Similar to wilderness, this protection provides social, economic and ecological benefits. Limiting road-building in the inventoried roadless areas minimizes negative environmental impacts of roads construction, maintenance, and automobile traffic. Inventoried roadless areas expand the system of protected federal lands to include ecosystems that were not very well represented in the current system of national parks, wilderness areas, and preserves including lower to mid-range ecosystems and in many areas provides a needed buffer from areas of motorized use to lands designated as wilderness.

Current inventoried roadless areas do not attract a great deal of recreational use and therefore tend to be socially, economically and ecologically sustainable, other than the issues plaguing ecological sustainability of the forest in general, like vegetation density.

Research natural areas (RNAs) contribute to ecological sustainability by permanently protecting and maintaining biological diversity. RNAs also contribute to social and economic sustainability. Three RNAs have been established on the Sequoia National Forest and three others are candidates for establishment.

The sustainability of RNAs has come into question. Across California, there is a question about the management of wildfires managed primarily to meet resource benefits in the RNAs. . Work has been done toward recommendations for fire management, both suppression and post-fire rehabilitation and restoration. In many cases, the occurrence of fire is necessary to maintain the target elements of the RNA, and whether or not fire suppression is desirable should be considered as part of the overall management of the RNA (Forest Service 2013).

Climate change presents a special challenge since the baseline or reference area may change. Climate will also affect biotic populations directly. The desired condition is a network of research natural areas that represents the full diversity of ecosystems found across the region, recognizing that each site is a dynamic ecosystem that will change over time. Size of the areas must be large enough to adequately represent the botanical feature to be researched and be protected from destruction such as climate change or fire. Redundant areas may be necessary (Forest Service 2013).

Scenic byways contribute to social, economic and ecologic sustainability similarly to the trails, although the experience may be less intimate and less physical. Scenic byways allow a different user group to have experiences with nature. Driving for pleasure is one of the most popular outdoor recreation pursuits in California and the country. Use of scenic byways also leads to economic benefits from tourism.

Information Gaps

Although the Sequoia National Forest does have important information relating to designated areas, including a large body of on the ground experience with these important forest areas, there are some information gaps relating to some of the designated areas. Wilderness character (untrammeled quality, undeveloped quality, natural quality, outstanding opportunities for solitude or a primitive and unconfined type of recreation quality) monitoring data in the Sequoia National Forest wildernesses is not available to establish a baseline for measuring trends.

CONCLUSIONS

Chapter 1: Ecological Integrity

Ecological integrity of terrestrial ecosystems varies with location and elevation on the Sequoia National Forest. At the highest elevations, in wilderness and subalpine and alpine, ecosystems are generally intact. There are some impacts from climate change, but they are limited. Trees may be moving up in elevation and there are potential effects of climate change with increasing fire frequency. Montane chaparral can replace upper montane forests if fire frequency and intensity increase. Past fire suppression has changed upper montane forests and diminished their ecological integrity. Rare trees and meadows are among the most vulnerable to climate change. Red fir forest and meadows are tied to snowpack. Snowpack has declined recently and is expected to melt earlier. Fire suppression and limited forest management has led to some increases in forest density, and uniformity of structure and fuels. These effects will continue and bring with them an increased risk of drought-related tree mortality, insect and pathogen outbreak, and more intense, high severity, large wildfires. Mixed conifer and pine forests in the montane ecosystems have been most impacted by fire suppression and past management. These forests are home to key species of conservation concern including the fisher and California spotted owl. Forests are denser, large tree densities are reduced and forest structure is more uniform. This has decreased the overall biodiversity of song-birds, woodpeckers, small mammals, and understory plants adapted to light and fire. The foothill zone has been the most altered as a result of extensive human development and non-native invasive grasses.

Ecological integrity of aquatic ecosystems has been degraded across most of the forest. Native trout are restricted to the highest elevations on the forest. Amphibians are disappearing from streams at lower elevations where they once occurred. Streams and high elevation lakes and the species contained in them face warming trends associated with climate change. Invasive species will continue to be a detriment to native fish and amphibian species. Modeled changes in precipitation, the elevations for rain and snow, and the timing of snow melt can all influence aquatic ecosystems in the future. Extensive water development has reduced the connectivity of habitat for some species such as the hard head minnow, and changed the habitat for others. Some meadows have lowered water tables from road placement, overgrazing in the late 1800s, water development, and recreation. Current meadow management is more controlled, but impacts remain.

Riparian ecosystems vary in ecological integrity depending on the part of the ecosystem considered. Many of the forested riparian areas occur in steep canyons and function as corridors for wildlife. Fire suppression has impacted riparian habitat by increasing conifer density and decreasing riparian hardwood and herbaceous vegetation, resulting in decreased habitat diversity for birds, bats, insects, and amphibians. However, meadows have resisted invasive plant species for the most part and contain special habitats such as fens and aspen. When rare plants, wildlife, and proper hydrologic function are considered, many meadows on the Sequoia National Forest have diminished ecological integrity. Aspen are threatened by the lack of fire, browsing and changing snow melt.

Chapter 2: Assessing Air, Soil and Water Conditions

Air quality is in non-attainment status, per federal regulatory standards, for ozone. It is also in non-attainment status, per state standards, for ozone $PM_{2.5}$ and PM_{10}. This has detrimental impacts on human and ecosystem health. Nitrogen deposition across the forest is high. Haze has reduced visibility in Class 1 air sheds in wilderness areas. Smoke is a health concern when uncontrolled wildfires are burning. Although prescribed fire and wildfires managed primarily to meet resource benefits are effective tools for reducing potential smoke from wildfires, poor air quality and the lack of public acceptance of smoke limit their use.

Soil has been modified in some areas, and in others is largely intact. There is risk from large, high intensity fires, floods, and changed timing of flows associated with climate change.

Water quality is generally good, except for local areas with streamflow diversions and temporarily high erosion rates. Water is a highly valuable commodity for municipal use, power generation, and agriculture. Water systems are extensively developed, which has negatively impacted aquatic biodiversity. Hydropower electric generation is vulnerable to changes in the water supply. Economic sustainability will be reduced by climate-induced changes in timing of peak flows and melting of snowpack, and drought will reduce hydropower production and amount of water available for drinking water irrigation, recreation, and other purposes. Sustainability of this valuable set of water-based commodities is threatened by changing river flows.

Chapter 3: Assessing System Drivers and Stressors

Fire suppression and past vegetation management have led to increased forest density and fuel loads. Consequently, fires are more intense and more severe, and forests are more vulnerable to insect and pathogen outbreaks and drought-related tree mortality. The rate of ecosystem restoration, whether fire or mechanical, is very low compared to the need. More climate change is expected. Warmer temperatures, along with more rain than snow are occurring. This change will intensify trends in fire, insect and pathogen outbreaks, and drought-related tree mortality. High ozone levels contribute to all of these factors, and decrease forest health. Invasive plant species are increasing, especially in the foothills. Once an invasive species dominates a site, fire patterns change and become more frequent and earlier in the season. Invasive species threaten the ecological integrity of aquatic systems, threatening native species. Overall, drivers and stressors have changed substantially and have cascading effects on reducing sustainability of ecological integrity and ecosystem services.

Chapter 4: Assessing Carbon Stocks

Climate change, shifted fire regimes, grazing, vegetation management, insect and disease, and population growth impact the amount of carbon the Sequoia National Forest can store. California’s national forests are expected to be net carbon sinks over the next several decades until the middle of this century. At that point, carbon losses from wildfire, disease, and other disturbances will exceed sequestration, and forests will become net emitters.

Chapter 5: At-Risk Species

There are currently 163 species identified as at-risk. Ten are federally listed under the Endangered Species Act (four as endangered, three as threatened, three as candidates) and the remaining 153 are preliminary species of conservation concern. Of the preliminary species of conservation concern, more than two thirds are plant species. These species occur in a wide range of ecological conditions although there is a concentration of species in a few key ecosystems: mature forests; aquatic, riparian, and meadow systems; and areas with gabbro or serpentine soils. Key ecosystem components such as large snags, down logs, riparian vegetation, and shrub fields are important for several at-risk species.

Key risk factors focus on climate change and how it may affect both the current and future distribution of habitat and habitat connectivity, in addition to how it will directly affect species sensitive to changes in hydrology, temperature, or the seasonality of weather. Severe fire is another key risk factor primarily affecting the short and long term availability and quality of habitats. Continuing and past impacts from livestock grazing may be a risk factor for several species, primarily those associated with aquatic systems, riparian areas, and meadows. Invasive species is a key risk factor for many species, both terrestrial and aquatic. Finally, habitat fragmentation and disturbance from human activities are key risk factors for several species, particularly as the human population grows and drives increased use and development in and adjacent to the forest.

Chapter 6: Assessing Social, Cultural and Economic Conditions

People are becoming increasingly disconnected from nature and outdoor experiences, particularly those who live in urban areas. Many people from culturally diverse backgrounds are underrepresented as visitors on national forests and other public lands. This disconnect may grow as populations, urbanization and cultural diversity increase. The three-county area where the Sequoia National Forest is located generally faces greater challenges to human wellbeing than California or the Sierra Nevada bio-region as a whole. With higher unemployment, lower earnings, lower per capita income and a higher percentage of households receiving earnings from lower income benefit programs, the counties bordering the forest are facing greater challenges to economic health than the state and bio-region as a whole. Sequoia National Forest communities are increasingly at risk from catastrophic wildfires. Total employment in timber sector jobs has declined in the three-county area. The travel and tourism industry supports 15.6 percent of the jobs, agriculture 5.6 percent, and mining 1.4 percent. Recreation activities make a small contribution to local economies in Tulare, Kern, and Fresno Counties. Water flowing off of the Sequoia National Forest is extremely important to the economy of the San Joaquin Valley, which may be adversely impacted by climate change, population growth, and increased demand and competition for water.

Chapter 7: Benefits to People

Continued enjoyment of the benefits obtained from key forest ecosystem services is vulnerable to the threat of uncharacteristic fire. Additionally, the increase in fire spending reduces the Sequoia National Forest's ability to take care of other management needs and threatens the sustainability of these services. Native grasses and plants used in tribal cultural activities often benefit from fire.

Chapter 8: Multiple Uses-Fish, Wildlife, Plants

Climate change is altering the timing, duration, and magnitude of stream flows, which is affecting fish species. Invasive fish have limited native trout to the highest elevations. California mule deer populations are slowly declining. Data on other hunted species are not available by forest. Invasive plants are altering the landscape. Floral diversity and abundance depends on fire return intervals within the natural range of variation. Large departures from the natural range of variation occur on the Sequoia National Forest, primarily in the montane zone.

Chapter 8: Multiple Uses-Range

The Sequoia National Forest supported heavy sheep grazing between the late 1800s and the 1950s. Overgrazing during this time was widespread and erosion was extensive. More careful management since then has improved allotment range conditions. Sheep grazing has been replaced by cattle grazing. The levels of grazing have been greatly reduced. Today, annual grasslands composed primarily of non-native species occupy what was once pristine native grassland. Introduced annuals are considered “naturalized” plant species and so are managed for, rather than as invading species which would be characteristic of poorer range sites. Livestock grazing is likely to be sustained within the planning area over the next 20 years based on recent site-specific range analyses.

Ecological restoration will contribute to the sustainability of grazing on the Sequoia National Forest. Meadow restoration will remain a priority. Livestock grazing promotes the maintenance of open space rather than urban development in the area as permittees are required to own base property ranches. An assessment is in progress by the Forest Service and the University of California at Davis to estimate trends over the last 20 years. Over 800 monitoring sites have been established on the national forests in California since 1999. Results from this study are expected in the fall of 2013 and will provide a more meaningful assessment of rangeland condition and trend and response to grazing management, as well as to weather and other factors. The results of this study are expected to be incorporated in the final Sequoia National Forest Assessment.

Chapter 8: Multiple Uses–Timber

Trends indicate warmer and drier growing conditions leading to increased tree mortality. There will be a need to improve forest resilience and critical wildlife habitat. Several tree species, such as the sugar pine, have been severely impacted by invasive rust. Mechanical treatments will contribute to increasing the pace and scale of ecological restoration where appropriate. These treatments will be used, along with prescribed burning and natural change agents such as wildfire, to effect needed changes.

Timber harvest on the Sequoia National Forest was over 60 million board feet (MMBF) in 1989 and has steadily decreased over time to 3.8 MMBF. The Sequoia National Forest moved away from even-aged reforestation management 20 years ago to stand maintenance thinning harvests intended to control density and growth of stands. Timber industry representatives say that approximately 25 MMBF will be needed from the Sierra and Sequoia National Forests to maintain the last remaining local sawmill infrastructure south of Yosemite National Park. Several wildland urban intermix fuels reduction and restoration projects are underway and more are planned. These projects are intended to create strategically located treatment areas to intercept wildfire originating in the more fire-prone foothills below. Maintenance of business infrastructure to support Forest Service restoration goals is a critical concern for the Sequoia National Forest, the tribes, other agencies and public utilities. Markets for excess or hazardous timber help defray the costs of required maintenance for facilities, roads, and fuels management.

Chapter 9: Recreation Settings, Opportunities and Access, and Scenic Character

Projected population growth in the Sierra Nevada and in the San Joaquin Valley and the limited ability of county governments to provide outdoor recreational opportunities will increase demand for outdoor recreation on National Forest System lands and will result in more people visiting the Sequoia National Forest in the future. While demand is going up, Forest Service budgets are decreasing. Fewer resources are available to maintain and operate existing recreation facilities, develop new opportunities, or provide management of dispersed recreation. An increasing backlog of maintenance is expected for existing developed sites. With diminishing budgets and increases in recreation demand associated with population growth, the sustainability of trails may be in question. Partnerships with multiple user groups are already an important part of how the Forest Service accomplishes its work. Partnerships and new management strategies will play an even more important role in maintaining and improving developed recreation facilities and trails on the Sequoia National Forest and will be critical to meeting recreation demand in the future.

Demographic shifts will change the types of recreation experiences people will be seeking and the ways managers will communicate with the public. Demand for developed recreation facilities for larger family and social groups exceeds the current forest capacity and is expected to increase along with the demand for more services and amenities in the future. People may become increasingly dissatisfied with the recreation opportunities provided if the forest does not have the capacity to manage its recreation facilities and opportunities and is unable to meet the public demand. With fewer commercial users maintaining portions of the National Forest Transportation System than in the past, and declining federal budgets, the Sequoia National Forest is expected to have challenges maintaining the road system to safety and environmental standards, resulting in a backlog of deferred maintenance. At the same time, public use of forest roads has grown steadily in recent years, and driving for pleasure is one of the most popular activities in national forests.

Existing vegetation conditions and fire regimes are outside the historic range of variation in many areas of the Sequoia National Forest, resulting in low scenic stability. The valued scenic character and scenic attributes are at risk of uncharacteristic disturbances such as severe wildfire that could have long-term effects on the scenic integrity in areas of concern.

Chapter 10: Energy and Minerals

New hydroelectric facilities are unlikely to be added on the Sequoia National Forest; however, there are plans for improvements to existing projects. It is unlikely that transmission corridors will be developed in the future on the forest. The need for additional energy from environmentally sensitive sources will likely increase requests for solar energy and wind energy locations on the forest. Even though biomass plants are being developed near the Sequoia National Forest, little interest has been expressed in harvesting forest products primarily for power production. Mining on the Sequoia National Forest is limited to the southern end of the forest. Current overall demand for gold, tungsten, and uranium is low. The Monument has been withdrawn from locating, entry and patent under mining laws.

Chapter 11: Infrastructure

The Sequoia National Forest road system consists of approximately 1,646 miles of roads as well as motorized and non-motorized trails. The transportation system offers many opportunities: vegetation management, fuel treatment, access to private in-holdings, fire management, utility management, special uses, recreation and harvesting of special forest products. The deferred maintenance for road infrastructure on the Sequoia National Forest is approximately $49.7 million. Over the past several years the Sequoia National Forest has had funding to maintain only a small percentage of its road system to safety and environmental standards. Despite this, major roads are in fair condition. The less travelled high clearance roads are becoming rougher and brushed in, making normal pickup access more difficult. There are also concerns that the majority of roads are not being maintained to the standards necessary to reduce adverse impacts to water quality. The forest has about 194 administrative buildings, and 247 recreation buildings, including many potentially historic structures. Forest staff maintains these to the best of their ability, but there is a backlog of deferred maintenance. The forest also has a large workload in managing special use permits, most of which are recreation residences, resorts, organizational camps, marinas, and outfitter-guides.

Chapter 12: Areas of Tribal Importance

Tribes are concerned about the continued protection of and access to culturally important resources and areas of tribal importance. Population growth and increasing pressure on public lands for recreation, water, and other resources may lead to increasing conflicts with Sequoia National Forest uses critical for maintaining tribal traditions and culture. Tribal traditions and culture are dependent upon the health of ecosystems, including disturbance regimes within their natural range of variation. Climate change could further impact resources and areas important to tribes.

Chapter 13: Cultural and Historical Resources and Uses

Cultural resource sites are at risk from a number of stressors including but not limited to: increasing use related to population growth; agency management practices that inadvertently create new threats such as fuels build up in or next to sites; deferred road, bridge, and building maintenance; illegal vandalism and looting; marijuana cultivation; wildfire; and climate change.

In general, cultural resources are inherently fragile and non-renewable. Efforts to programmatically manage adverse effects to sensitive cultural resources are further hindered by major data gaps in the number, location, and condition of cultural resources on the Sequoia National Forest. Seventy percent of the forest is not inventoried to standard and of the 10,000 cultural resources thought to exist on the forest, approximately 7,000 have no documentation. Data gaps of this magnitude make it difficult to provide a snapshot of current cultural resource condition.

Documented cultural resources, particularly on the Kern River Ranger District, are in a declining trend in areas heavily used by the public. It would be reasonable to assume that undocumented cultural resources in those areas are also in a declining trend. Many of these sites are valuable for research potential, interpretive value related to heritage tourism events, and Native American cultural significance. Efforts to develop programmatic strategies to reduce overall impacts to sensitive classes of cultural resources are stymied by the lack of data on the resource.

Chapter 14: Lands

People have a strong connection with public lands and the Sequoia National Forest. Connections are based on generations of use and exploration, as well as traditions that are still in the making. The trend is toward increasing population, which may create more demand to develop the private lands within and adjacent to the forest. More demand will be placed on public land for community uses such as water systems and sewer facilities. Land use for private land located within the Sequoia National Forest boundary is under the control of the local county. The county defines the appropriate type and intensity of use in its County General Plan and administers this direction through zoning ordinances.

Chapter 15: Designated Areas

The Pacific Crest National Scenic Trail and other national recreation trails are maintained through successful partnerships with user groups. Partnerships will be critical to maintain these trails in the future. People are attracted to and congregate in areas close to water bodies. The sustainability of wild and scenic rivers, especially in high-use dispersed camping areas, is in question. These treasured resources will face heavier human pressures in the future with projected population growth and climate change. Effective management, partnerships, and public communication strategies are needed to develop site stewards.

About 26 percent of the Sequoia National Forest is wilderness. Wilderness use is light on the Sequoia National Forest. There is one new proposed wilderness, the Moses Wilderness. Current forest inventoried roadless areas cover about 29 percent of the Sequoia National Forest. These roadless areas experience light visitor use and tend to be socially, economically, and ecologically sustainable in areas with ecological conditions within the natural range of variability. The sustainability and ecological integrity of research natural areas is at risk as a result of fire suppression, climate change, and invasive species. There is one scenic byway, the Kings Canyon Scenic Byway, on the Sequoia National Forest. No efforts are underway to designate other byways.

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HELPFUL LINKS

Current Sequoia National Forest Land and Resources Management Plan
http://www.fs.usda.gov/main/sequoia/landmanagement/planning

US Forest Service Pacific Southwest Region Plan Revision website
http://www.fs.usda.gov/main/r5/landmanagement/planning

USFS Plan Revision website
http://www.fs.usda.gov/planningrule

Sierra Cascades Dialog
www.fs.usda.gov/goto/r5/SequoiaCascadesDialog

Our Forest Place
http://ourforestplace.ning.com/

The Living Assessment
http://livingassessment.wikispaces.com/

PSW Science Synthesis
http://www.fs.fed.us/psw/publications/reports/psw_sciencesynthesis2013/index.shtml

History page for Sierra Nevada Forest Planning
http://livingassessment.wikispaces.com/Brief+History+of+Sequoia+Nevada+Forest+Planning

USFS Pacific Southwest Region Ecological Restoration
http://www.fs.usda.gov/detail/r5/landmanagement/?cid=STELPRDB5308848

Forest Service Road Accomplishment Reports
http://www.wildlandscpr.org/2006-and-2007-road-accomplishment-reports-rars

Forest Service Travel Management
http://www.fs.usda.gov/main/r5/recreation/travelmanagement

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